# INTERAVIA

REVIEW OF WORLD AVIATION

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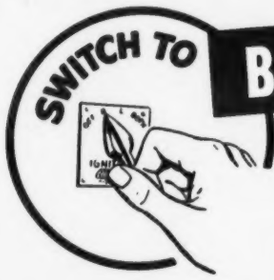
## Aerial Pipeline

VOLUME V 11 1950

# "Reduce High Voltage Difficulties at Any Altitude!"

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*Review of World Aviation*

Volume V — No 11 — 1950

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*Front Cover*

*The detachable fuselage being towed away from the twin-engined Fairchild XC-120 "Packplane".*


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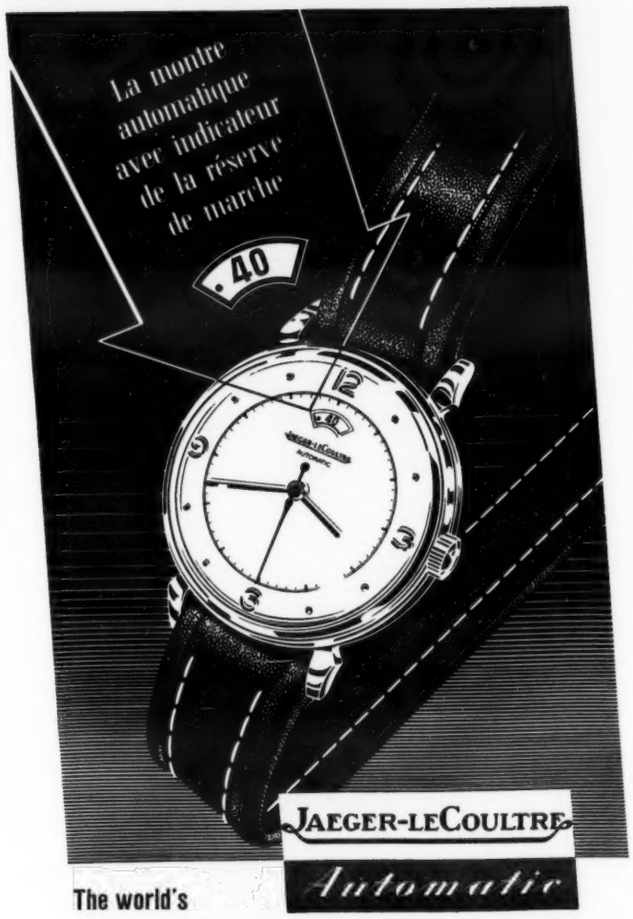


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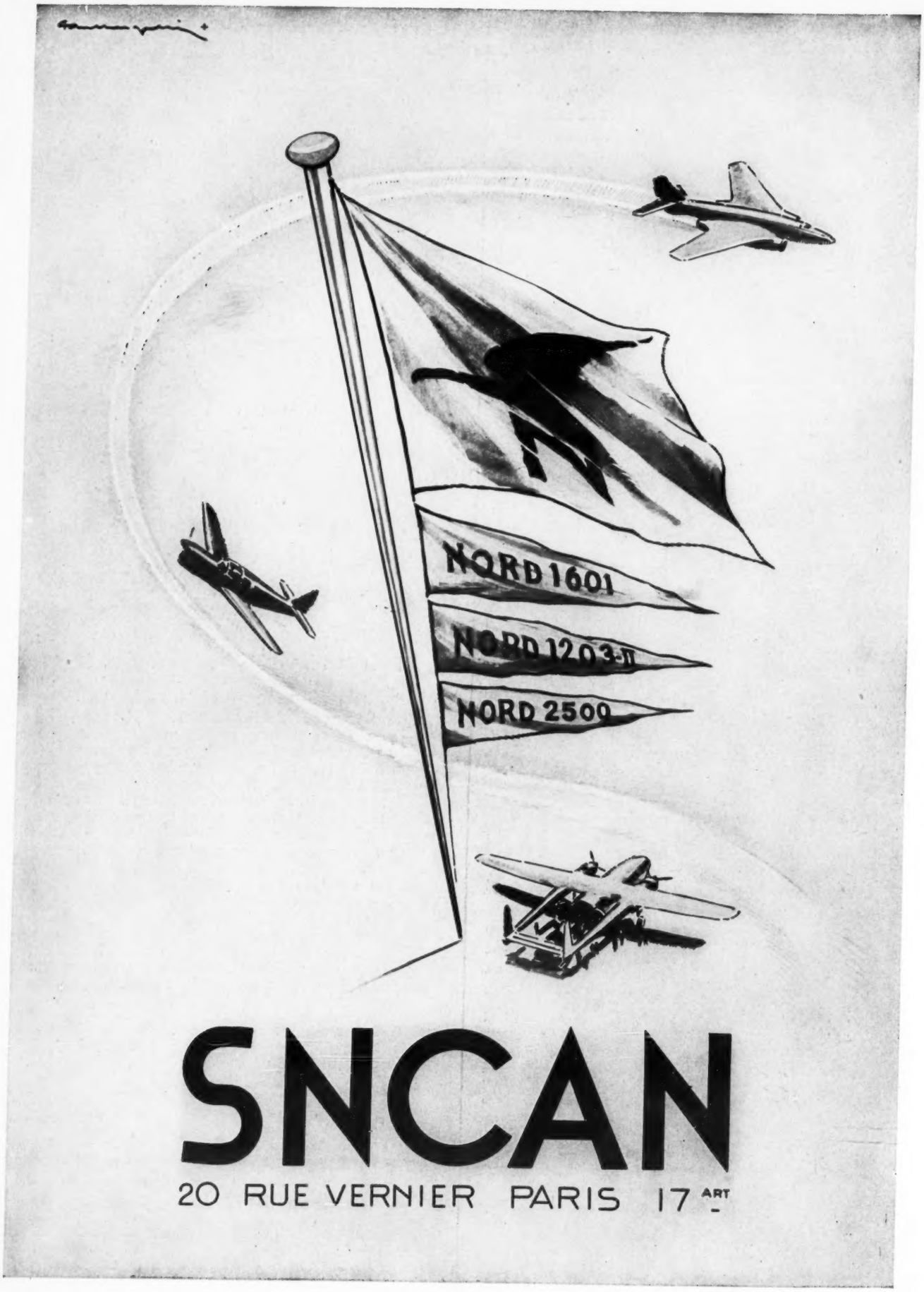
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## at the front in Korea

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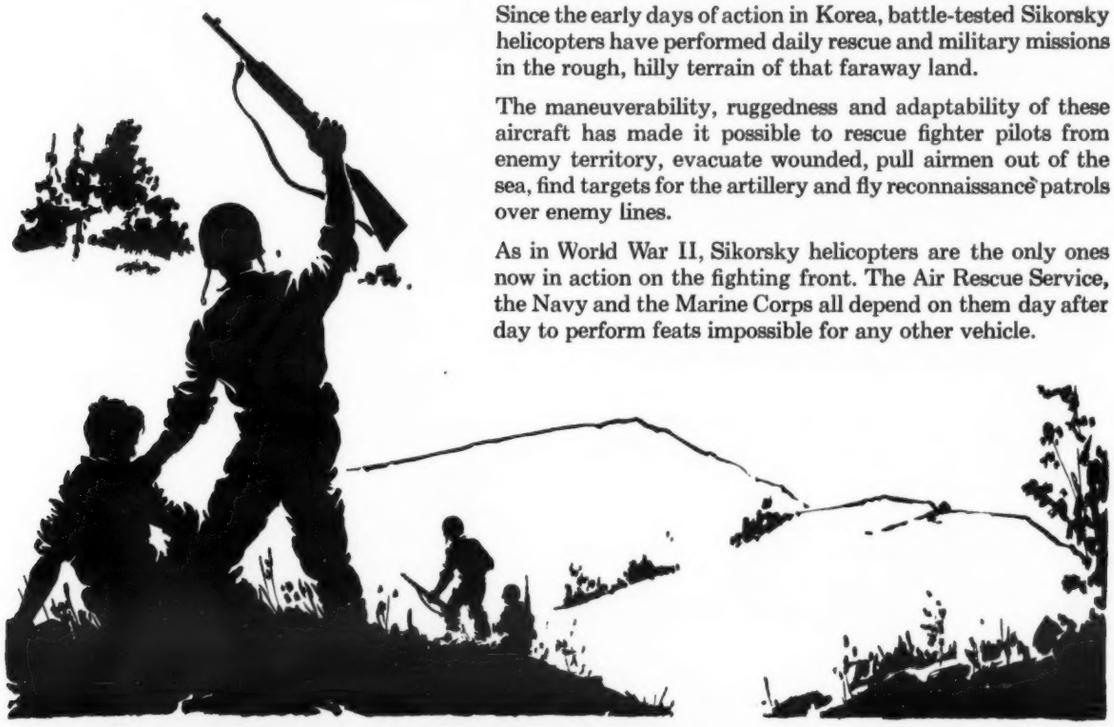
As in World War II, Sikorsky helicopters are the only ones now in action on the fighting front. The Air Rescue Service, the Navy and the Marine Corps all depend on them day after day to perform feats impossible for any other vehicle.



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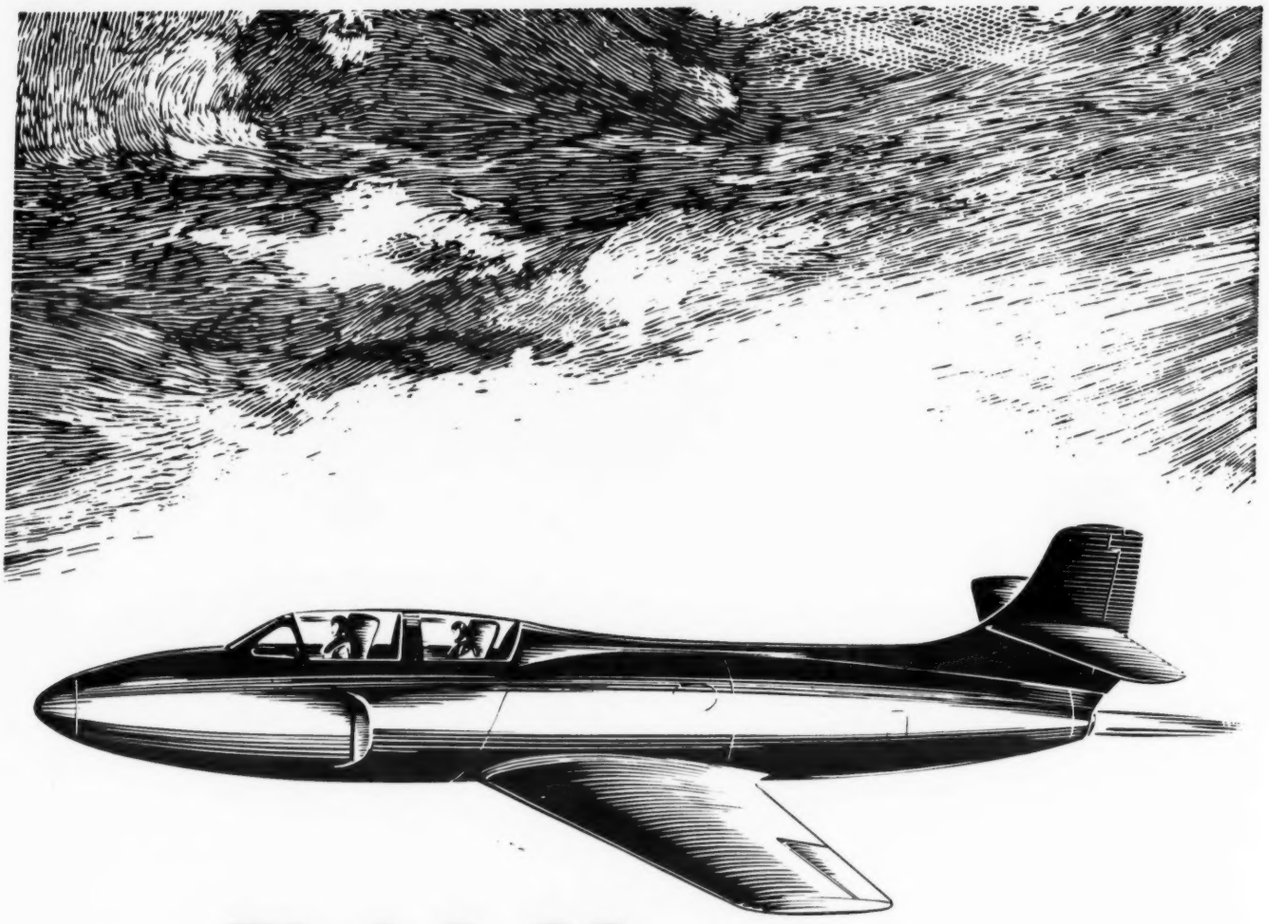

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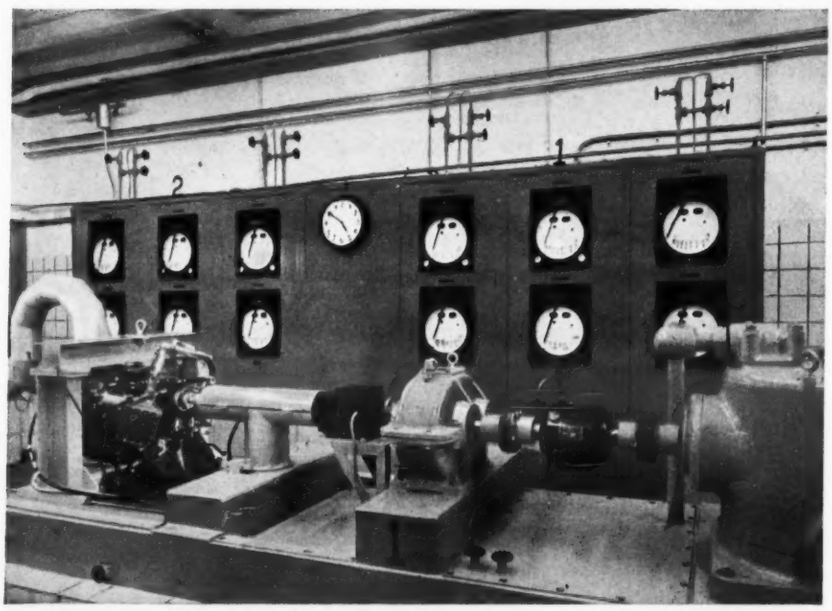

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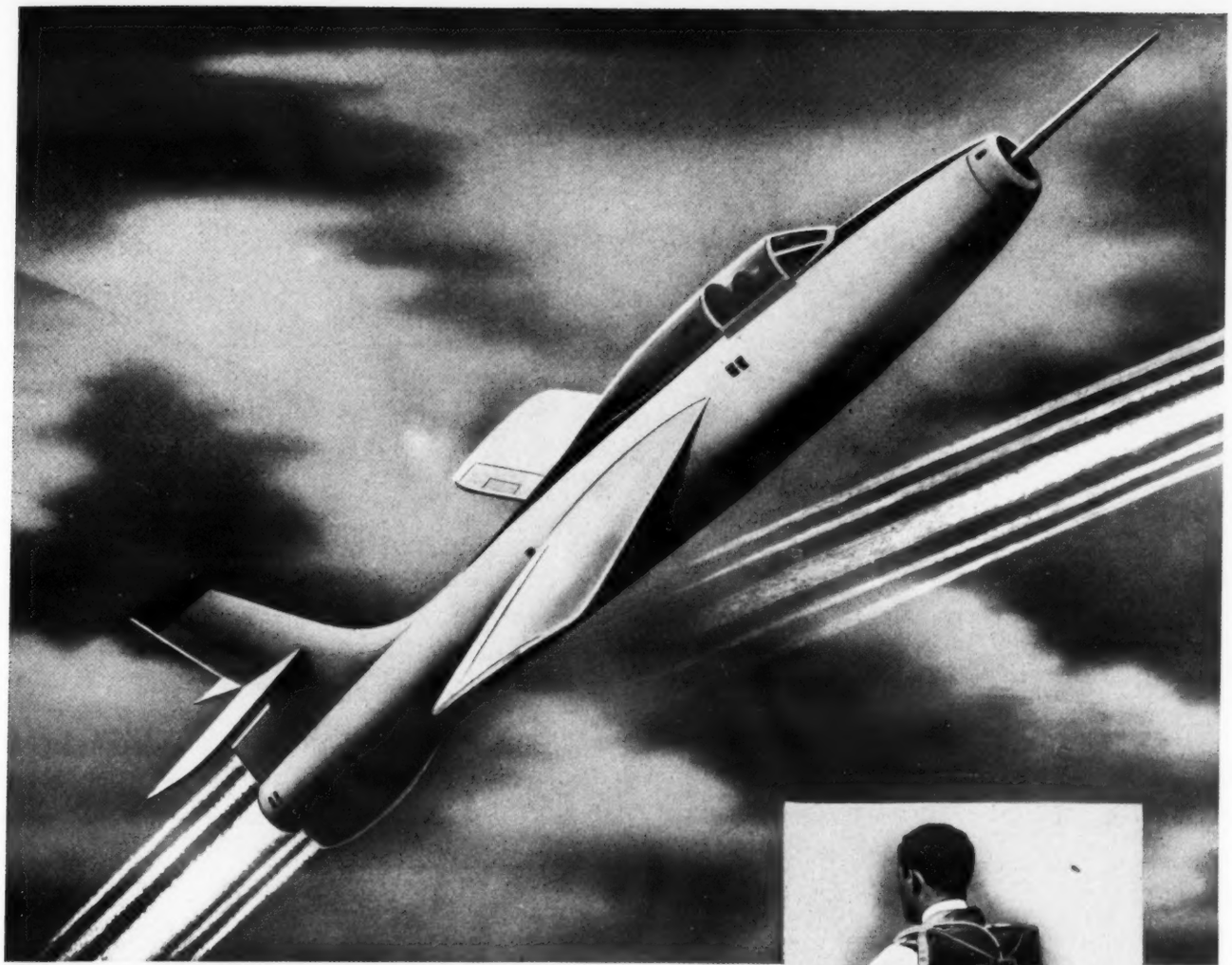

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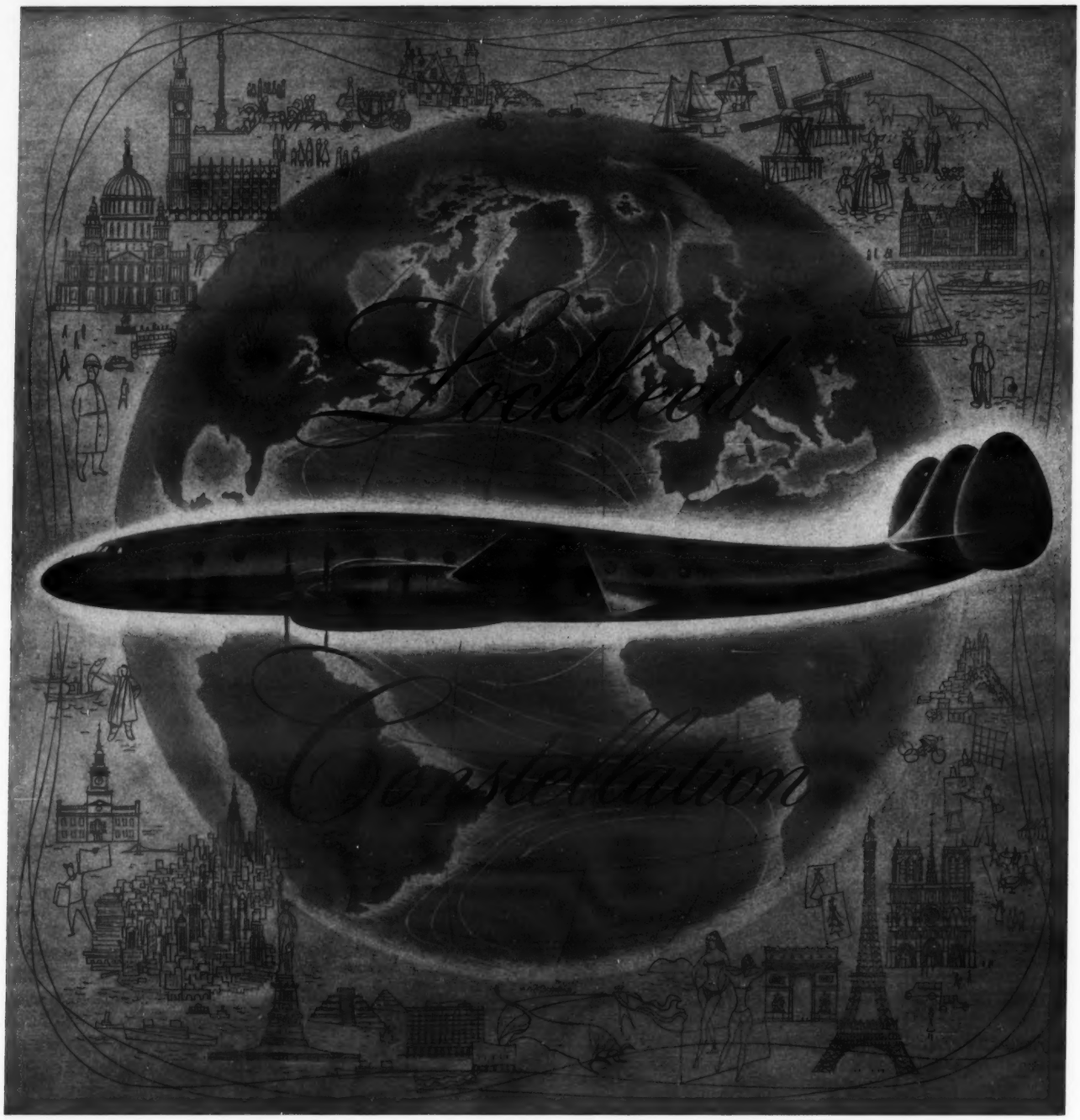


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# Korean Airlift

*Since "Supplies" have grown wings . . .*

Not so very long since—thirty, perhaps forty years ago, before the first World War—it was the custom for combatant officers in all countries rather to look down their noses at the supply services. Transport units ? Necessary people no doubt, but you could scarcely call them soldiers ! No, they were "errand boys," who carted their heavily-laden trucks of bully-beef and biscuits—and perhaps an occasional case of ammunition—around in the rear, so that the men who did the fighting should not go hungry. "War demands first and foremost a valiant army . . . and secondly supplies and firemen." Such was the pre-1914 attitude.

And today ? Since "Supplies" have grown wings, and have developed into the *military air transport organisation,* they have become an elite force. During World War I they moved up into the firing line. Today air transport missions reach far into enemy territory. No matter what term is used, *Logistics, Ravitaillement, Rifornimento* or *Nachschubwesen,* the General Staffs of all nations are agreed on the strategic importance of the supply services. Slowly but surely we have come back to the opinion of Julius Caesar, who declares in his "De Bello Gallico" that the supplies system is of paramount importance in warfare. "Supplies" have indeed become quite "presentable," since Princess Elizabeth of England served with the British transport units during World War II !

Without the efforts of the *airborne supply services,* i.e. the *airlifts* from USA to Japan and from Japan to Korea, victory by the United Nations forces would have been inconceivable.

*It takes time . . .*

On 27th May, 1941, at the height of the battle for Crete, Churchill wrote the following somewhat despondent letter to General Ismay, of the Combined Chiefs of Staffs Committee :

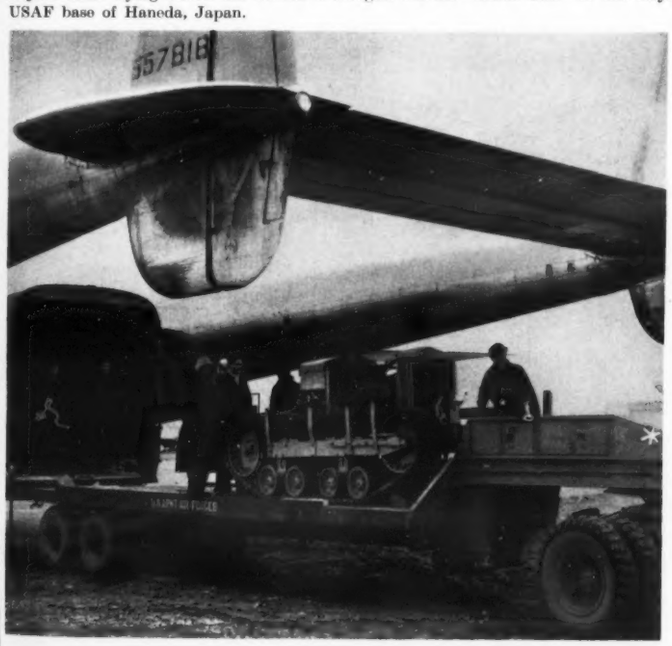
". . . This is a sad story (about parachute troops and gliders) . . . The gliders have been produced on the smallest possible scale, and we have practically now neither the parachutists nor the gliders, except these 500 . . . Thus we are always found behindhand by the enemy. We ought to have 5000 parachutists and an Airborne Division on the German model, with any improvements which might suggest themselves from experience. *We ought also to have a number of carrier aircraft* (i.e. transport aircraft). These will all be necessary in the Mediterranean fighting of 1942, or earlier if possible . . . A whole year has been lost, and I now invite the Chiefs of Staff to make proposals for trying, so far as is possible, to repair the mis-fortune." *

There was no mistaking the meaning of this epistle. But more was needed than a mere demand even by Churchill. So long as suitable transport aircraft and the necessary experience were lacking, large-scale air transport services could not be conjured up overnight.

Incidentally, the Germans would have thought themselves fortunate if they had indeed possessed the organisation imputed to them by Churchill. At that time even they could not think of mounting large-scale airlift operations. True, their air landings in Norway, Holland and Crete had been successful. But they lacked the type and quantity of transport aircraft required to maintain regular supplies over long distances and for a long period. The failure of the subsequent Tunisian and Stalingrad airlift experiments was due not only to the absence of efficient fighter cover. Even the six-engined Messerschmitt Me 323 inevitably failed as a military transport aircraft. It was a clumsy contraption with wooden wings, a span of over 178 ft., and a dizzy speed of 135 m.p.h. !

* Cf. Winston S. Churchill : The Second World War, Vol. III, p. 683 (Ed.).

*The first two successful airlifts. Left :* A Fairchild C-82 "Packet" on the Berlin airlift loading a tractor for beleaguered Berlin at Frankfurt's Rhein-Main airfield. *Right :* After flying across the Pacific a Douglas DC-4M "North Star" of the Royal Canadian Air Force lands 27 fully-equipped soldiers for the Korean battlefield at the USAF base of Haneda, Japan.



A Fairchild C-119 "Packet" transport of the Japan—Korea airlift is being loaded with supplies for the advancing UNO forces. The scene is at Wonsan airfield shortly after Wonsan's liberation.

The Messerschmitt Me 323 "Gigant," designated by the Germans as a "giant transport," could indeed carry an astonishing amount of freight. The snag was that this clumsy colossus could only fly at 135 m.p.h. (220 km/h) and was shot down by the dozen when it was used for the German airlift to Tunisia.

However we may look at it, the airlift operations of World War II were failures, one and all—whether it was the Tunisian or the Stalingrad operation, or, on the other side, "Operation Hump" (India-China—468 aircraft losses !) or other attempts in the Atlantic or Pacific.

But even if suitable transports had been available, the necessary experience and the no less indispensable ground organisation were completely lacking at that time. A brief visit to a nearby airfield is sufficient to show us what is required for an airlift. In spite of the most rigid military discipline even military transports are powerless unless they have suitable installations for take-off and landing, such as runways, lighting, fuel supplies, navigation and blind landing aids, supplies of compressed air, etc. In the field where none of these things exist they must be brought up by the airlift aircraft themselves before there can be any question of inaugurating an airlift operation.

The recent airlift operations between USA and Japan and between Japan and Korea, which have succeeded beyond all expectations, could never have been accomplished without the experience gained during the Berlin airlift. And they would have been inconceivable if Pan American Airway had not opened the San Francisco-Honolulu service 15 years earlier (on 22nd November, 1935), if commercial air carriers had not opened up one Pacific island after the other—Wake, Midway, Kwajalein, Guam, and the rest.

*8750 miles... USA—Japan.*

Major-General Laurence S. Kuter could rely on his officers and men. This point did not give the Commander of the US Military Air Transport Service (MATS) the slightest cause for concern when he was dragged out of bed on the night of 25th June 1950 and instructed to expand the existing airlift from USA to Japan to warlike proportions and organise another airlift from Japan to Korea.

It was only eight weeks since his men had shown what they could do. "Exercise Swarmer," which had been held at the end of April 1950, had produced such convincing results that it could be broken off half-way through the scheduled time. It had taken only six days instead of eleven to deliver 21,468 fully-equipped troops and 15,578 tons of supplies to an "air-head" established in "enemy" territory. With such personnel Major-General Kuter could embark unhesitatingly on the task of bridging the 8750 miles between the USA and Korea.

He was, however, worried about quantity—the number of aircraft and pilots available. On the evening of 25th June MATS had only the following :

| | |
|---|---|
| 241 | Douglas C-54 "Skymasters" of the USAF, |
| 27 | Douglas R5D "Skymasters" of the US Navy, |
| 10 | Lockheed C-121 "Constellations," |
| 10 | Douglas C-74 "Globemasters," |
| 7 | Boeing C-97 "Stratofreighters," |
| Total 295 | Transport aircraft... |

The Douglas "Dakota" was no longer mentioned.

Of this figure of less than 300 aircraft only 60 were allocated to the Pacific Command of MATS. If MATS had been a pure training organisation it would simply have detailed all the remaining 240 aircraft for airlift service, and all would have been fine.

But this was not so. An article on the air transport organization of the USAF, published elsewhere in the present Review, shows that MATS has very practical and world-wide transport assignments to fulfil, that its regular Atlantic flights are quite indispensable to the overseas units of the American Armed Forces, and that not only the USAF but also international air traffic depend one way or another on its weather reports and its air rescue service.

The utmost that MATS could do without jeopardizing its other essential services was to divert forty four-engined transports for operation in Korea, thus increasing the transport potential of the Pacific air lift by 70 %. However, as the transport requirements of the Far Eastern theatre were growing daily by leaps and bounds, the Supreme Command decided on a general SOS.

Naturally it was American civil and military aircraft that first answered the appeal. The USAF ordered the 61st and 62nd Troop Carrier Groups (a total of 75 C-54's) to assist MATS. In addition, American commercial air transport companies provided 63 Douglas DC-4 "Skymasters" and 3 Boeing 377 "Stratocruisers." Altogether the following aircraft had been chartered up to 10th August :

| | |
|---|---|
| American | 7 DC-4 |
| AOA | 1 Boeing 377 "Stratocruiser" |
| Alaska | 3 DC-4 |
| Braniff | 1 DC-4 |
| California Eastern | 1 DC-4 |
| Capital | 2 DC-4 |
| Delta | 1 DC-4 |
| Eastern | 4 DC-4 |
| Flying Tigers | 6 DC-4 |
| National | 1 DC-4 |
| Northwest | 3 DC-4 |
| Overseas National | 5 DC-4 |
| Pan American | 2 Boeing 377 |
| | 8 DC-4 |
| Seaboard & Western | 4 DC-4 |
| Trans Ocean | 7 DC-4 |
| TWA | 4 DC-4 |
| United | 6 DC-4 |
| Total | 66 civil transports. |

But other countries, too, decided within the first month to offer active assistance. On 20th July the *Canadian Government* sent the

426 Long Range Transport Squadron of the Royal Canadian Air Force (six Douglas DC-4 "North Stars" built in Canada) to the MATS base at McChord. Later *Canadian Pacific Airlines* provided three four-engined aircraft, and the *Belgian Government* sent a Douglas C-54 "Skymaster," chartered from Sabena. (Two others have since followed.)

These aircraft delivered a total of 15,000 men and over 1,500 tons of war material in Tokyo during the first 40 critical days of hostilities, the following routes being flown :

1. *Military aircraft :* Fairfield-Suisun AFB (east of San Francisco)—Hawaii—Johnson—Kwajalein—Guam—Tokyo.
   Total distance 8083 miles, flying time 40 hours.
2. *Civil transports :* Fairfield-Suisun AFB—Hawaii—Wake—Tokyo.
   Total distance 6718 miles, flying time 34 hours.
3. *Military and civil aircraft : Great circle route :* McChord AFB (near Tacoma)—Anchorage (Alaska)—Aleutians—Shemya—Tokyo.
   Total distance 5688 miles, flying time 30 hours.

On 21st August details of the United Nations offensive against North Korea were worked out at a meeting of the Chiefs of Staff of the three defence services with General MacArthur in Tokyo. Now the airlift was working at full pressure. On 15th September a Handley Page "Hastings" of RAF Transport Command carried 33 British soldiers for Korea from Singapore to Manila and thus opened a "branch airlift," which was operated twice a week via Manila and Japan.

Before the American Pacific airlift had been put on a war footing only 70 tons *a month* had been carried by air from USA to Japan. By the end of August 1950 100 tons of personnel and freight were being carried *every day*. Priority goods included the following : blood plasma, medical supplies, rockets, ammunition, tank parts, machine guns, radio equipment, flying instruments, navigation equipment, aircraft parts.

The airlift personnel became past masters at the art of packing freight simply and lightly so as to save every possible ounce of packing material on the Pacific flights and thus increase the payload to the greatest possible extent. (By rights the American air transport companies should have paid MATS compensation for the special training received by their freight personnel.)

Early in October 1950, one of the records set up during the Berlin airlift was broken. In view of the distances involved, the Pacific lift could not compete with the Berlin as far as weight of goods transported or frequency of flights is concerned. A three-minute service such as operated towards the end between Frankfurt and Berlin could not for obvious reasons be organised between San Francisco and Tokyo. It was already a magnificent achievement that an aircraft could take-off from USA for the Pacific every 75 minutes. However, on 2nd October the total daily distance flown on "Operation Vittles" was exceeded by 10,000 miles *(Berlin airlift* 242,000 aircraft miles, *USA—Japan* 252,000 aircraft miles).

Within the space of three months roughly 8000 tons of urgently-required goods and military personnel were flown across the Pacific by MATS and its civil charter aircraft. Thirty-four thousand passengers (troops and technicians) were carried to Japan and 15,000 to USA. During the same period 4,400 wounded and sick were taken by air to American hospitals. To ensure proper care of the patients during flight, MATS employed 300 flight nurses for the Pacific Command and 225 for the Continental Command in USA.

*Japan—Korea.*

On the Japan—Korea stage the airlift's most sensational achievement was the transportation of an aluminium pontoon bridge 650 ft. long and 256 tons in weight. Thirty-six Fairchild C-119's, 3 Douglas C-54's, 23 Douglas C-47's and 9 Curtis C-46's flew the parts of the bridge over in a bare three days and thus set up a world record. The Japan—Korea airlift can pride itself on being the first to transport a complete bridge.

*Air Rescue Service and Weather Service.*

*MATS' Air Rescue squadrons* operated so successfully in Korea that in future air rescue squadrons with special equipment are to be placed at the disposal of the Chief of Staff of the Air Force ready for deployment to any spot on the globe.

In Korea the principal aircraft used were SB-17 Naval aircraft with droppable lifeboats, Sikorsky H-5 helicopters and Douglas "Dakotas," the Sb-17's undertaking protection of the Japan-Korea section of the airlift, whilst the helicopters were responsible for carrying wounded out of the firing line and for the search for missing pilots. In some cases severely wounded were flown direct to Japan without changing aircraft.

*The Weather Service* of the Korea Command was also a living proof of the fact that transport organisations are no longer restricted to the rear echelon. Long before the liberation of South Korea MATS weather observers were flying over the whole of the peninsula to beyond the 38th parallel, so as to provide the independent fighter and bomber units and the larger units of the ground troops with regular weather reports.

*The General has done his bit, now it's up to you. . . .*

The war in Korea will, we hope, have become past history by the time this article appears in print. We have all seen pictures of General MacArthur, seen how he directed the landing operations, heard of the laurels presented to him by President Truman. Korea has brought action by UNO and a new chapter in the glorious annals of the great American General of the Pacific.

It may be, however, that Korea—even more than Berlin—has been a victory for "supplies with wings." What could even Douglas MacArthur have done if he had not been able to fly fresh life-blood from the American continent to his closely pressed bridge-head, within the space of forty hours ? Could it be that the real victor in Korea is Major General Laurence S. Kuter, Commander of the Military Air Transport Service ?

This General, little known outside the United States, gave a brief talk before the Society of Automotive Engineers in Washington on 19th April, 1950, i.e. a few weeks before the Korean conflict, on the tasks and aims of military air transport. What he had to say on that occasion was less a criticism than a suggestion. His subject was "*The Transport Airplane related to Future Military Plans.*" Whether we like it or not, military planning is closely linked with civil planning. If there are good military transport aircraft there will also be good civil transport aircraft. At the moment air transport is still the Cinderella of the budget and can only hope for progressive designs if the military get the money to plan new types. For this reason Kuter's remarks directly concern not only military airlifts but also commercial aviation. If Kuter's success in the Pacific helps forward his suggestions, then Lockheed, Douglas, Boeing and the others will soon have the resources necessary to push commercial air traffic another step forward. Meanwhile let us not take too much comfort from the so-called prototype bill. To provide 12½ million dollars for *testing* (not the design) of aircraft is only doing things by halves.

What conclusions did Kuter then reach in his talk ?

He stated that as regards the *quality* of civil or military transport aircraft, no very outstanding improvements were to be expected before 1955. He reminded his hearers that it has in the past always taken five years to develop an existing type a little further. Model C-54A becomes model B, C or finally even M, and model C-54M is

*Two successful airlift commanders. Left : Major General William H. Turner,* Chief of the Berlin airlift. *Right : Rear Admiral William G. Tomlinson,* who as C-in-C, Pacific, American Military Air Transport Service (MATS), was responsible for the airlift to Korea.

then still more or less similar to model C-54A. That is how it is with all transport aircraft.

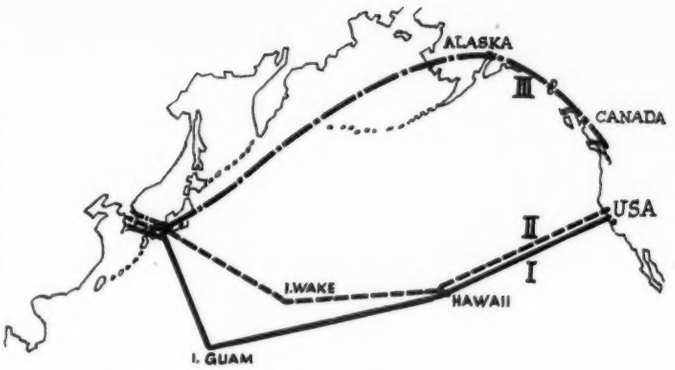
He also pointed out that MATS, his own organisation, still had to load and unload all freight by hand—except in the case of the Fairchild C-119—and that the loading hatch of one of the commonest four-engined transports was ten feet above the ground. This means that infantrymen with full equipment must climb up and down a ladder, which by no means speeds up transport movements.

Kuter feared, in April this year, that the American military budget was aimed less at increasing the number of transport aircraft available than at ordering transport aircraft with a greater payload.

He carried his pessimism so far that he did not even dare hope for a fleet of jet transports by 1955. He thought that, here too, development would be hampered by lack of funds.

So spake Kuter. And as he said this at a time when Johnson was still dictator in the Pentagon he prudently forebore to criticize. He contented himself with purely academic remarks.

Since Korea a whole lot has changed. Uncle Sam has learned anew from Korea that a transport fleet may be decisive in global armament or even global warfare. It has also come to Uncle Sam's ears that the British have new designs which surpass the Americans or—which Uncle Sam certainly does not like—would be capable of driving American suppliers out of the market.




The three routes used for the USA—Korea airlift.

And as Uncle Sam is at the moment digging deep into his pocket it is possible that Kuter's call may not go unheeded. It is possible that Douglas, Lockheed and Boeing will ultimately be given the means to design and construct efficient, really up-to-date military transport aircraft. Should the Korean airlift have contributed towards this end, then the almost super-human efforts of General Kuter and his men will not have been in vain.

# The U.S. Military Air Transport Service

*PEACE-TIME CINDERELLA*

An air transport organization able to announce quite casually that it is carrying a daily load of one hundred tons of cargo and men to a theatre of war nine thousand miles away evidently is a substantial operation. But if it is considered that this tonnage was built up from practically nothing in less than two months and at the time of disclosure was still rising daily, this performance is a truly amazing proof of the value of an experienced military air supply system.

The US Military Air Transport Service—it was "MATS" which announced this figure—is by no means conceited about its feat, only moderately proud. It feels that, had it not been hampered in its development, it might have done even better. In fact, many a logistics expert in the USA and elsewhere has had occasion to find that every time a lull occurs in the international political situation, MATS is being starved of men, equipment and funds for reasons of economy and subsequently has to make superhuman efforts in order to fulfil its functions. For, as soon as an emergency arises, Cinderella MATS automatically becomes the object of frantic appeals, hasty criticism and inevitable improvisation.

That MATS won the Berlin airlift battle now is a matter of history. During that time it concentrated eighty percent of its personnel strength and half of its air fleet on "Operation Vittles." Some of the aircraft released after the successful completion of the mission were subsequently reassigned to the old military transport routes MATS had previously operated to various parts of the world. Immediately, a howl of protest arose from the commercial airlines, notably when MATS resumed its South American operations. The commercial operators pointed out that *they* were perfectly capable of handling all US military transport needs in that area. The result was that MATS' South American schedules were drastically curtailed.

Similarly, in the early spring of this year MATS had to suspend its non-stop transcontinental service in the USA, between Washington and Fairfield-Suisun AFB, California. It was explained that the domestic operations of MATS now were mostly cargo services—there was an increasing trend to authorize military personnel on urgent duty to travel by commercial airline. A little later came the announcement that the MATS trans-Atlantic service would be reduced. In March, 1950, USAF Chief of Staff General Hoyt S. Vandenberg declared in Washington that the Service was gradually being withdrawn from regular air route operation and was slated for conversion to purely training duties. Somewhat paradoxically the General said that "henceforth, MATS' primary mission will be readiness for war . . ." That the policy of retrenching MATS—a shabby way to treat a victor !—was being implemented was proved in an anouncement issued at the end of May, 1950, to crown all the preceding promulgations : this official release stated, in effect, that the Pacific routes of MATS, already sharply curtailed, would be discontinued altogether on July 1st, 1950. The US Department of the Interior, which was assuming jurisdiction of 97 islands of the US Trust Territory of the Pacific, had gone on record in favour of awarding all air service responsibilities to the commercial carriers . . . Where would the US be today without MATS' Pacific services ? Six days before the appointed date, the North Koreans launched their aggression.

*FORMATION AND DUTIES*

The decision to form the Military Air Transport Service by the integration of the USAF's Air Transport Command and the US Naval Air Transport Service was a result of the recommendations in 1947 of the President's Air Policy Commission (Finletter Report) and of the Congressional Air Policy Board. The Finletter Commission specifically urged the "consolidation of ATC and NATS into one military transport service for the Army, Navy and Air Force." In February, 1948, the Secretary of the US Defence Department accordingly issued a plan for the merger of the two branches, and at the same time he announced the appointment of *Major-General Laurence S. Kuter*, USAF, as Commander-Designate and *Rear-Admiral John P. Whitney* as Vice-Commander-Designate. On May 3rd, 1948, the Secretary of Defence issued a directive ordering the establishment of MATS with effect from June 1st, 1948, and detailing the organization and mission of the new Service. And on May 26th the Chief of Staff of the US Air Force sent out a letter to the officers concerned in the setting-up of MATS giving a point-by-point outline of the Service's responsibilities.

Briefly, this letter fixed June 1st, 1948, as the date of MATS' establishment, under the command and direc-

Major General Laurence Sherman Kuter, Commander of MATS. Kuter is an old bombardment and Air Transport Command officer ; for two years (1946-1948) he was the US representative on the Council of ICAO, with the personal rank of Minister.

Cyrus R. Smith, Chairman of American Airlines, will take over the assignment of Vice-Commander, MATS, with the rank of Major-General, in the event of an emergency mobilization. He was a Brigadier-General in USAF Air Transport Command in the last war.

tion of the Chief of Staff of the Air Force, by the merger of USAF Air Transport Command and US Naval Air Transport Service. All ATC elements were reassigned to MATS, but the Navy kept some of its transport units for its own use. The directive also *assigned to MATS the USAF's Air Weather Service (AWS), the Airways and Air Communications Service (AACS), the Air Rescue Service (ARS) and the Flight Service (FS).*

This obviously meant that the scope of MATS' activities was designed to go far beyond those of a mere transport auxiliary to the armed services, and the detailed description of the Service's duties bears this out. MATS' functions, as outlined in the Chief of Staff's directive, include the transportation by air of personnel (including the evacuation of sick and wounded), materiel, mail, strategic materials and other cargoes for all agencies of the National Military Establishment and as authorized for other US Government agencies. However, MATS was not to be responsible for the tactical air transportation of airborne troops and their equipment, nor for the supply of forward combat areas or for air transport on routes of sole Naval interest.

MATS also was charged with the establishment and operation of its own facilities at home and abroad, with the ferrying of aircraft whenever needed, the maintenance of flying aids over its routes, the training of its own personnel, the preparation of plans for transport operations and for equipment, collaboration in the design, redesign, modification and flight testing of military transport aircraft, study and elaboration of flight control practices, participation in the development of all-weather flight practices.

Further : liaison between the civil air carriers and the USAF for the utilization by the latter of the services and facilities of the commercial carriers ; preparation of plans for the employment and expansion of plans in national emergencies.

A tall order . . .

## *ORGANIZATION*

That MATS has known how to get down to hard work is amply demonstrated by its performance in maintaining 79,000 miles of air routes at home and abroad and by the two feats highlighting its achievements, Berlin and Korea. A year after its formation, the Service was able to report on this "experiment in unification" that integration had worked effectively and profitably. Staffs of MATS headquarters, Continental and Pacific Divisions were manned by officers of Navy and Air Force. "On the bases, personnel of the two Services work and live together . . . there is no evidence of friction," the report states.

Twenty-six days after MATS was established, the Russians blockaded Berlin. On March 30th, 1949, nine months later, the Service was responsible for supplying and maintaining the 317 Douglas C-54 transports needed to keep an operating level of 225 such machines on the flight lines in Germany. The way MATS performance in "Operation Vittles" increased is illustrated by a few fragments from an imaginary "MATS" diary :

JUNE, 1948

*June 21st :* Berlin Blockade imposed by Russians.

*June 30th :* MATS and other USAF components begin indirect support of Airlifts. Some C-54s of USAF Troop Carrier Command go to Germany to relieve the old C-47s. They are followed by nine of MATS' own C-54s. Some MATS aircraft of the same type placed in trans-Atlantic support of Air Lift.

JULY, 1948

*July 23rd :* MATS sends 72 Douglas C-54s to Germany. Major-General William H. Turner is alerted to form Air Lift Task Force Headquarters in Germany.

Major General Caleb V. Haynes, Deputy Commander for Services, MATS.

SEPTEMBER, 1948

USAF directs MATS to establish a Replacement Training Unit at Great Falls, Montana, for the training of 100 three-man Airlift crews a month.

NOVEMBER, 1948

*November 9th :* Two MATS Navy Transport squadrons start carrying cargo into Berlin.

*November 24th :* MATS receives first of 10 Lockheed C-121 "Constellations" and assigns it to Atlantic Division.

DECEMBER, 1948

Third Navy Transport Squadron joins Airlift.

MAY, 1949

*May 12th :* Suspension of Berlin Blockade announced, but airlift to continue at reduced rate to build up adequate stockpiles in Berlin.

The success of the Air Lift was due chiefly to the tight and efficient organization of MATS—not to speak of the unselfish expenditure by all participants of financial, material and personal resources. It may be useful, therefore, to take a quick glance at the organization of the service :

From a functional standpoint, therefore, MATS' organization combines two broad phases :

1) *air transportation ;*

2) *essential support services* available to MATS and all the other branches of the US Military Establishment.

Under the Commander and Vice-Commander, one Deputy Commander directs MATS' air transport activities. Another Deputy Commander is responsible for the operation of the supporting services, Newfoundland Base Command, and the transit bases in Bermuda, Tripoli and Saudi Arabia. Operationally speaking, these overseas bases and areas have as primary mission the support of the MATS air route system, which in turn facilitates the mobility of the entire US Air Force.

## FUNCTION 1 : AIR TRANSPORTATION

### *ATLANTIC DIVISION*

Headquarters of the Atlantic Division is Westover Air Force Base, Chicopee Falls, Mass. From that point, the Division's services radiate to Bermuda, the Azores, England, Paris, Frankfurt, Rome, Athens, North Africa and Saudi Arabia. From Mobile, Ala., the Division operates to the Caribbean and South America.

In normal, "uneventful" times—it must be admitted that these have been limited since the formation of MATS, what with Berlin and Korea—the Service uses "Constellations" on a high-speed service across the Atlantic to Frankfurt, huge Douglas C-74 "Globemasters" on heavy cargo hauls to Europe, the Caribbean and South America, and "Skymasters" to other points along the Division's route network.

### *CONTINENTAL DIVISION*

Primary operational mission of the Continental Division includes ferrying of aircraft, domestic feeder services to the MATS overseas routes, domestic air evacuation, training, and the "Transcontinental" coast-to-coast service. It also carries out scheduled flights—formerly the responsibility of the Pacific Division—from the USA (Great Falls, Montana) to Ladd AFB, Fairbanks, and Elmendorf AFB, Anchorage, in Alaska. It supplies Adak, the outpost in the Aleutians, and other northern points with fresh vegetables and other perishables by a flight from Anchorage. Normally, "Skymasters" are used for all these flights, but in times of emergency these large transports were transferred to other duties and replaced with the trusty old Douglas C-47.

### *PACIFIC DIVISION*

Prior to the Korean war, MATS transport operations in the Pacific were conducted with Boeing C-97 "Stratofreighter" and Douglas "Skymaster" aircraft. At the present time, any large equipment capable of flying as far as Japan is being pressed into service. Normal operations call for services to Japan via the Aleutians, via Honolulu, Wake Island and Iwo Jima and direct from Wake to Tokyo. Other points served are Johnston Island, Kwajalein, Guam, Manila, Okinawa, Adak, Bangkok, Calcutta, New Delhi, Karachi and Dhahran, where the Pacific Division links up with the Atlantic operation.

In addition to these regular transport activities MATS operates an *air evacuation fleet* of "Skymasters" (for some domestic flights, C-47 "Skytrains") to carry US military patients home from all parts of the world. Furthermore, the Service possesses a Special Mission Fleet of ten

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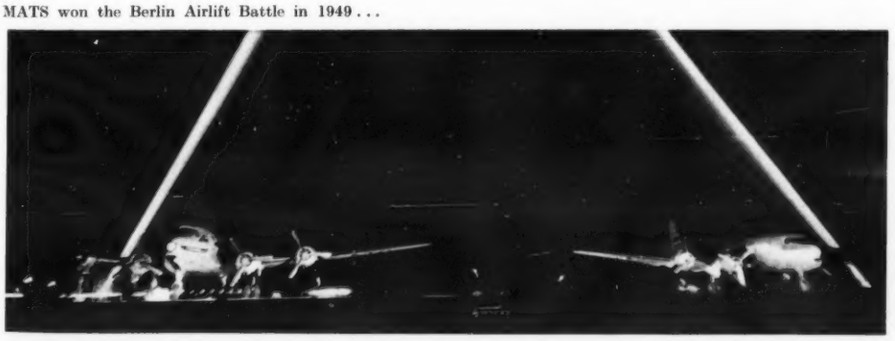
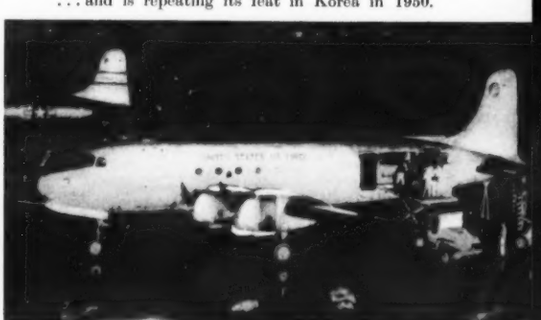
MATS won the Berlin Airlift Battle in 1949 . . .



. . . and is repeating its feat in Korea in 1950.



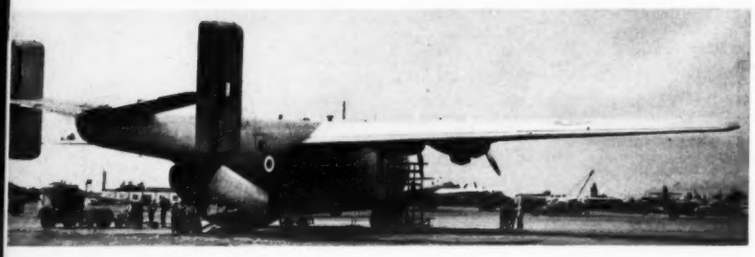
**Flying Pipeline**

# Military Transport Aircraft

*FRANCE*

*Bréguet 761 "Deux Ponts":* Four-engined mid-wing monoplane with double-decker fuselage. This type is in series production and is to be used not only for pure freight transport but also for mixed passenger and freight traffic.—The Bréguet 761-01 prototype is fitted with four SNECMA 14R engines of 1575 HP (1600 CV) each. A preliminary series of three aircraft featured Pratt & Whitney R-2800 B-31 "Double Wasp" engines of 2000 HP (2030 CV) each, and the Bréguet 763 series model is to have P & W R-2800 CA-18 "Double Wasps" of 2400 HP (2440 CV) each. The prototype is authorised for a take-off weight of 88,000 lbs. (40 tonnes), the preliminary series for 99,000 lbs. (45 tonnes) and the series version for 106,000 lbs. (48 tonnes). Span 140 ft. 11½ in. (42.96 m), length 94 ft. 11-3/4 in. (28.93 m), wing area 1195.6 sq.ft. (185.4 m²), cargo space 2897 cu.ft. (167 m³).—The version with a take-off weight of 99,000 lbs. (45 tonnes) can carry a payload of 33,070 lbs. (15,000 kg) over a distance of 620 miles (1000 km) at aspeed of 217 m.p.h. (350 km/h).

*GREAT BRITAIN*



*Blackburn & General Aircraft GAL-60:* After the Bristol "Brabazon" the biggest landplane of British design. The GAL-60, of which only the prototype has so far been built, is designed for both civilian and military use.—All-metal high-wing monoplane with double fin and rudder unit and fixed nose wheel undercarriage. Four Bristol "Hercules 761/261" engines of 2000 HP each (2030 CV).—Span 162 ft. (49.4 m), length 99 ft. 2 in. (30.3 m), wing area 2916 sq.ft. (272 m²). With a take-off weight of 100,000 lbs. (45,360 kg) the GAL-60 can carry a maximum payload of 32,256 lbs. (14,630 kg) in its cargo space of 5,760 cu.ft. (162 m³). Even for a range of 1750 miles (2800 km) the payload is still 15,950 lbs. (7235 kg) for a speed of 164 m.p.h. (264 km/h).—The GAL-60, which has been developed at the request of the Ministry of Supply, is said to be particularly economical in flight.

*SOVIET UNION*

*Ilyushin Il-12:* This twin-engined low-wing monoplane with retractable undercarriage is used in large numbers in the Soviet Union as troop transport and freighter. In addition the Il-12 is also used as public transport aircraft on the services of the Czech CSA and the Russian Aeroflot companies.—With two Ash-82 FN double bank radial engines of 1675 HP each the Il-12 attains a maximum speed of 250 m.p.h. (405 km/h). The economic cruising speed is between 205 and 210 m.p.h. (330 and 340 km/h).—With a take-off weight of 38,000 lbs. (17,250 kg) the payload is 8820 lbs. (4000 kg). This can be carried over a range of 775 to 1200 miles (1250 to 2000 km).

*USA*

*Fairchild C-82 "Packet":* This all-metal shoulder-wing monoplane with two Pratt & Whitney R-2800 "Double Wasp" engines of 2,100 HP (2130 CV) each has a span of 106 ft. 6 in. (32.5 m), a length of 77 ft. 1 in. (23.5 m), a wing area of 1400 sq.ft. (130 m²) and a cargo space of 2312 cu.ft. (65.5 m³). The normal all-up weight is 50,000 lbs. (22,680 kg), the maximum permissible take-off weight 54,000 lbs. (24,500 kg). For a range of 500 miles (800 km) a payload of 13,000 lbs. (5,900 kg) can be carried. However the "Packet" has a maximum range of 3,900 miles (6,280 km) for its economical cruising speed of about 150 m.p.h. (250 km/h).—The C-82 produced in 1941 was developed by Fairchild in 1947 into the C-119 "Packet," with more powerful engines, bigger load capacity and improved performance. Details of the XC-120, a further development of the C-119, are given elsewhere in this issue.

*Douglas DC-6A "Liftmaster"* is the name of a freight aircraft derived from the four-engined DC-6 transport aircraft. In the design of the "Liftmaster" the wings, tail unit and undercarriage were taken over unchanged from the DC-6. On the other hand the new freight model has a fuselage which is about 5 ft. (1.5 m) longer, such as is also used in the Douglas DC-6B (passenger version of the DC-6A).—The "Liftmaster" features four Pratt & Whitney R. 2800 CB-17 "Double Wasp" engines with a take-off output of 2500 HP (2540 CV) each with water/methanol injection. Span 117 ft. 6 in. (35.7 m), length 105 ft. 7 in. (32.1 m), wing area 1463 sq.ft. (135.9 m²), cargo space 5,000 cu.ft. (142 m³), take-off weight over 100,000 lbs. (45,400 kg), payload 30,000 lbs. (13,620 kg) over 2100 miles range (3380 km) with a cruising speed of over 300 m.p.h. (480 km/h) ; maximum range 4540 miles (7300 km).

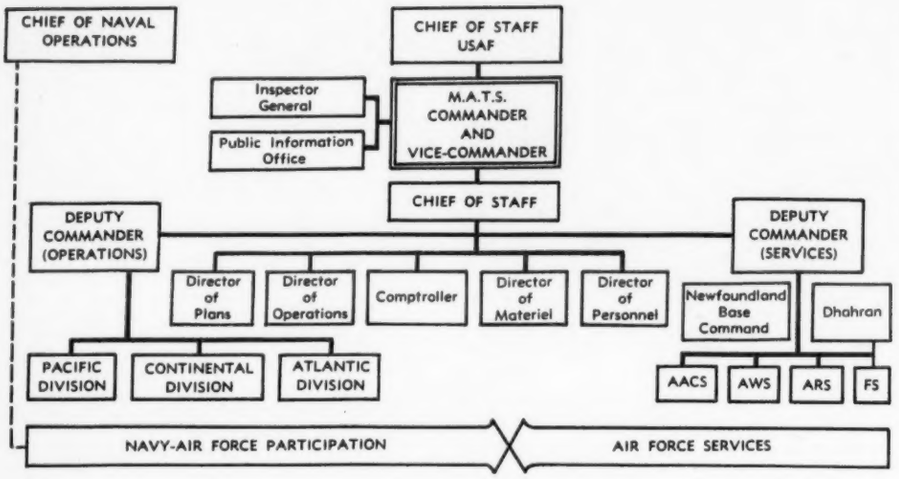
*Lockheed R-70 (L-1049 C) "Super Constellation":* A further development of the Lockheed "Constellation" to be fitted with four Wright "Turbo-Cyclone 18" compound engines of 3250 HP (3300 CV) each. The R-70 will have 30% more engine power than its predecessor, its fuselage is 18 ft. (5.5 m) longer and its payload 40% greater.—Span 123 ft. (37.5 m), length 113 ft. 7 in. (34,6 m), all-up weight 130,000 lbs. (58,970 kg).—Our picture shows the prototype of the "Super Constellation" (L-1049) standing next to a "Constellation."

*Boeing C-97A "Stratofreighter":* A freight and transport aircraft derived from the four-engined B-29 "Superfortress" long-range bomber, the C-97A also served as prototype for the development of the Boeing "Stratocruiser" transport aircraft. The "Stratofreighter" and "Stratocruiser," the B-29 and B-50, all have the same wing, tail unit and undercarriage design. However, the design of the fuselage differs considerably between these various aircraft, according to the use to which they are put. Unlike the B-29 and B-50 bomber types, the "Stratocruiser" and the "Stratofreighter" feature a double-decker fuselage. Freight capacity for the latter is 6470 cu.ft. (183 m³). Like the transport version the "Stratofreighter" has four Pratt & Whitney R-4360 "Wasp Major" 3500 HP (3550 CV) engines. Span 141 ft. 3 in. (43.1 m), length 110 ft. 4 in. (33.6 m), wing area 1720 sq.ft. (159.8 m²), take-off weight 148,000 lbs. (61,130 kg), maximum payload 53,000 lbs. (24,040 kg), payload over range of 4500 miles (7240 km) for a cruising speed of over 300 m.p.h. (480 km/h) over 10,000 lbs. (4555 kg).—During test flights the C-97A has flown with a total all-up weight of 174,500 lbs. (79,150 kg) and a payload of 96,500 lbs. (43,770 kg).

*Douglas C-74 "Globemaster":* This type was originally to be used on PAA's routes, but is now, since PAA withdrew their order, used only as a military transport.—Like the C-97A, the "Globemaster" is fitted with Pratt & Whitney R-4360 "Wasp Major" 3500 HP (3550 CV) engines.—Span 173 ft. 3 in. (52.8 m) length 124 ft. 1½ in. (37.8 m), maximum take-off weight 165,000 lbs. (74,840 kg), maximum payload 50,000 lbs. (22,680 kg). Recommended cruising speed is 300 m.p.h. (480 km/h), and maximum range—with unspecified payload—is over 7000 miles (11,000 km).

*Douglas C-124 "Globemaster 2":* Derived from the C-74, with the same wing, tail unit and engines. The C-124, 29 of which have been ordered by the USAF, has a cargo space of over 10,000 cu.ft. (283 m³). If the aircraft is to be used as troop transport the fuselage can be divided into two decks. Capacity 200 men with field equipment.—Span (like C-74) 173 ft. 3 in. (52.8 m), length 127 ft. 2 in. (38,7 m), wing area 2510 sq.ft. (233.2 m²). Take-off weight is 175,000 lbs. (79,380 kg) payload 50,000 lbs. (22,680 kg) for a range of over 2400 miles (4860 km).

*Consolidated-Vultee XC-99* is the transport version of the Convair B-26 heavy bomber. Wings, engines and undercarriage are the same in both types. The XC-99 has six Pratt & Whitney R-4360 "Wasp Major" 3500 HP (3550 CV) engines operating pressure propellers.—Span 230 ft. (70.1 m), length 182 ft. 6 in. (55.6 m), all-up weight 265,000 lbs. (120,000 kg), payload 100,000 lbs. (45,360 kg), cargo space 30,000 cu.ft. (850 m³), range 8100 miles (13,000 km). For shorter stages it is hoped to be able to carry a maximum payload of 116,000 lbs. (52,620 kg).—The XC-99 has been undergoing modification at the Convair Works for the past year. The P &W R-4360 engines of 3000 HP (3040 CV) originally used were replaced by those with a power of 3500 HP (3550 CV). This meant reinforcing the wing. On 3rd July the modified XC-99 took off on its (second) maiden flight and it has since become known that a series of long-range flights is to be made by this aircraft with maximum payload.




*Following from page 555.*

aircraft at Washington National Airport (eight "Skymasters," one C-121 "Constellation" and one C-118—or DC-6—"Independence"), manned and flown by 101 crew members. These aircraft are at the disposal of "Very Important Persons" engaged in missions of unusual urgency and importance. Approximately 18 missions are performed per month, varying from six to twenty-six days per mission.

During the 1949 fiscal year, MATS flew a total of 106,323 passengers, including 61,154 members of the USAF. Since the Service charges other Government agencies at cost for services rendered to them, MATS can even boast some traffic revenue : $620,471.30 for the same fiscal year. For a network of about 70,000 miles, linking military supply depots and other establishments in the USA to every corner of the globe where American forces are established, neither the passenger nor the revenue volume is excessive.

## FUNCTION 2 : SUPPORT SERVICES

Because of the inter-dependence which binds four of the Services and the common characteristics of support which mark them all, these organizations have been placed under the command supervision of a *Deputy Commander, Services,* MATS, who functions under the control of the Commander and Vice-Commander. The Services are organized and managed in a manner which enables them to support the entire Air Force and, in some instances, other branches of the US armed forces. Three of them, weather, communications and rescue, are global in concept and operation.

### *AIRWAYS AND AIR COMMUNICATIONS SERVICE*

AACS is the first of the MATS support services run on a global scale and provides communications and navigational facilities, including air traffic control services, to MATS, the USAF, US Navy and, at times, to pilots of civil airliners and military aircraft of other nations. From more than 200 carefully chosen operating locations throughout the world, AACS' 16,000 men, using more than 1100 electronic installations, provide 19 different kinds of indispensable communications and navigational services. Fifty-three per cent of AACS personnel are stationed outside the USA, along the Arctic Circle and the Equator, in Tripoli, Trinidad, Berlin, Hawaii.

The extent to which US military aircraft rely on the assistance provided by AACS is shown by the following statistics of the Service's performance in the 1948 and 1949 fiscal years :

| | *Fiscal year :* 1948 | 1949 |
|---|---|---|
| Control tower contacts | 14,009,176 | 19,115,000 |
| Point-to-point (words) | 634,035,222 | 815,412,372 |
| GCA Instrument approaches | 172,767 | 244,308 |
| Weather Traffic (words) | 27,603,519 | 20,061,000 |

A particularly important rôle was played by AACS in "Operation Vittles," which during the 1948-49 winter months was threatened with failure on more than one occasion. The solution of the weather problem in the crowded corridors rested largely upon AACS facilities and personnel. AACS GCA crews blind-landed more than 50,000 flights, surveillance radar enabled AACS traffic controllers to "look" 100 miles down the corridors over Russian territory and to correct the spacing of aircraft. On the average, AACS made a radio contact every four seconds during the Berlin Airlift, handled a landing or take-off every 30 seconds, a blind landing every four minutes. The Airlift hit its peak on Easter Sunday, 1949, when it carried almost 13,000 tons of supplies into Berlin. AACS averaged a radio contact every two seconds that day, and its flight controllers handled 2,764 arrivals and departures at Berlin.

### *AIR WEATHER SERVICE*

AWS provides global meteorological information to the Air Force and the Army. It is a tightly integrated organization of nearly 10,000 men, operating nearly 200 weather stations, five aerial reconnaissance squadrons and twenty-five mobile units scattered all over the world. Functioning in close cooperation with the US Weather Bureau and Naval Aerology, its basic framework consists of : an operational network to observe and record surface weather data ; an analysis and forecast network to assemble these data in usable form ; and a communications network, operated by AACS, to collect weather information and deliver it where needed. In addition, there is an upper air observing network consisting of 62 fixed and 15 rawinsonde reporting stations operating in an area extending eastwards from Japan to Saudi Arabia. These stations are equipped to make 4 radio-sonde and 4 radio wind observations daily.

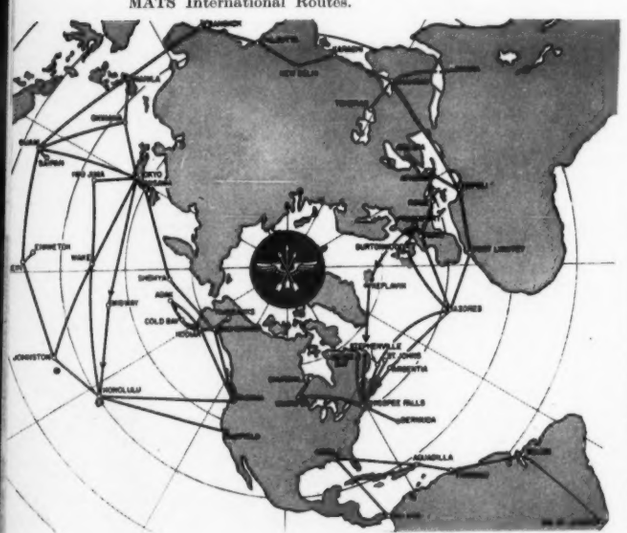
Perhaps the most dramatic phase of AWS is the long-range weather reconnaissance operations carried out daily by the Service's 55 Boeing RB-29 "Superfortress" four-engined aircraft, organized in five squadrons. Four of them perform reconnaissance missions, while the fifth provides air support for projects involving atmospheric research and trains replacement personnel. Scheduled synoptic weather flights to the extent of 14,000 nautical miles daily are made throughout the year over the North Atlantic, Northeast and Northwest Pacific and the Arctic (North Pole). Typhoon reconnaissance is conducted in the West Pacific on high priority as soon as such disturbances exist or are suspected. The same applies to hurricane reconnaissance in the Gulf of Mexico, the Caribbean and the Atlantic Ocean.

Air Weather Service provides regular information to US and foreign commercial airlines in various parts of the world, notably at Rhein-Main, Dhahran, Tokyo, in the Aleutians, the Panama Canal Zone, etc.

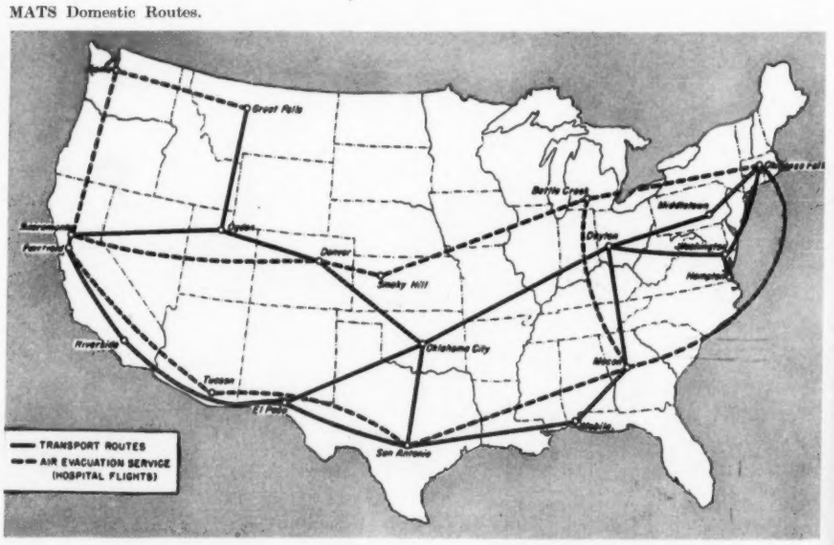
### *AIR RESCUE SERVICE*

ARS was created to meet problems arising during World War II. Its major mission is to save the lives of the crew of aircraft which fail to reach their destina-

MATS International Routes.



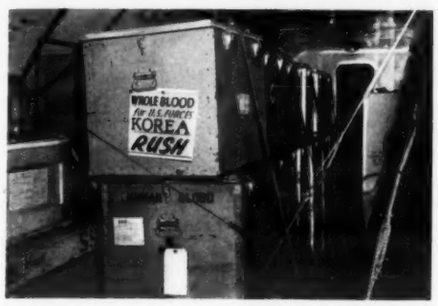
MATS Domestic Routes.



tions. When notified that an aircraft is overdue, ARS immediately attempts to establish the last known position of the lost craft. Weather data is then relayed to the search and rescue units. When the missing aircraft is discovered, aid is given the crew by dropping medical attendants, supplies, etc. ARS functions until survivors are returned to safety or search has to be abandoned.

One of the most highly publicized rescue missions carried out by ARS in recent years was the Greenland Ice Cap mission in the 1948-1949 winter to locate and rescue the survivors of a C-47 which had crashed in the interior of Greenland. After a long battle of men and aircraft against wind, snow and subzero temperature, and following several unsuccessful attempts at rescue by gliders and other equipment, a RATO-equipped C-47 finally made a successful evacuation.

The extent to which ARS is capable of covering the "politically accessible" parts of the globe is revealed by the location of ARS squadrons and flights.




Blood plasma comes high on MATS' cargo priority list for shipments to Korea.

The *Zone of Interior* (USA) is covered by three squadrons : the 5th, covering the US Atlantic Coast area, at McDill AFB, Florida, which has subsidiary flights at Maxwell AFB, Ala., and Westover AFB, Mass ; the 2150th, covering the Pacific Coast area, with headquarters at Hamilton AFB, San Rafael, Cal., with subsidiary flights at March AFB, Riverside, and McChord AFB, Tacoma, Washington ; the 2151st, for the interior of the USA, with headquarters at Lowry AFB, Colo., and flights at Biggs AFB, in the South and Selfridge AFB, in the North.

*Atlantic area :* The 6th Squadron at Harmon AFB, Newfoundland, with flights at Goose Bay, Labrador ; Lagens Field, Azores ; Kindley AFB, Bermuda ; plus a "civilian flight" at Keflavik, Iceland.—2153rd Rescue Unit at Dharhan, Saudi Arabia ; the 2154th at Wheelus Field, Tripoli, Lybia ; and the 2155th at Hickam AFB.

One of the duties of MATS is the evacuation of wounded. Picture shows a "Stratofreighter" hospital aircraft being unloaded at Fairfield-Suisun AFB, Calif.

*Pacific area :* The 2nd Squadron at Kadena, Okinawa, with a flight at Clark AFB, Philippines ; the 3rd at Yokota, Japan, with flights at Misawa and Ashiya, Japan ; the 4th at North Field, Guam.

Separate air-sea rescue organizations are maintained by the USAF in its four major theatres of operations, namely, Europe, the Panama Canal Zone, the Central Pacific (Hawaii), and Alaska.

At the present time, a standard air-sea rescue flight has the following personnel and equipment strength :

*Personnel*

20 officers,
70 enlisted men

(including a 5-man parachute rescue team and a 6-man ground rescue team).

*Equipment*

2 Boeing B-29 long-range search aircraft, or
2 Boeing B-17 life-boat-carrying aircraft
2 Consolidated "Catalina" amphibians
2 Fairchild C-82 "Packet" transports,
2 Sikorsky Helicopters
2 Short-range liaison aircraft
1 Motor truck
1 Jeep
2 tracked vehicles ("Weasels")
2 airborne lifeboats, etc.

It is evident that in the event of major rescue operations ARS will call on regular USAF units for help. Rescue attemps involving dozens of long-range bombers and even Naval flying-boats have repeatedly been reported in recent years.

*FLIGHT SERVICE*

The basic function of Flight Service is the promotion of flying safety. The nine operational FS centres are situated in the United States, and FS facilities are used by MATS, USAF, Navy, Coast Guard, Marine Corps and Army.

FS accomplishes its mission by keeping track of aircraft in flight, providing advisory services, clearing aircraft, surveying airfields for emergency use, formulating hurricane evacuation plans, alerting ARS on overdue aircraft, and reporting violations of flying regulations.

The nine FS centres are housed in close proximity to corresponding AACS, AWS and ARS bases, with which they are in frequent contact. The FS areas and their centres are :

McChord FS Area : Tacoma, Wash.
Hamilton FS Area : Fairfield, Calif.
March FS Area : Riverside, Calif.
Lowry FS Area : Denver, Colo.
Carswell FS Area : Fort Worth, Tex.
Wright-Patterson FS Area : Dayton, Ohio.
Maxwell FS Area : Montgomery, Ala.
Olmstead FS Area : Middletown, Md.
McDill FS Area : Tampa, Fla.

*BASE COMMANDS AND NATIONAL INTEREST BASES*

"In such areas outside the Continental limits of the USA, where there is no other US military authority charged with that responsibility, the Commander of MATS will have and will exercise all normal responsibilities of theatres of operation, area commands, or base commands," states the Department of Defence directive of May 3rd, 1948.

MATS bases outside the US fall into three general classes, as follows :

*National Interest Bases* of importance as MATS transit stops : Newfoundland, Greenland, Labrador, Saudi Arabia. They are under the control of Deputy Commander, Services.

*MATS Route Bases* supporting MATS routes : Bermuda, Tripoli and the Azores under MATS Atlantic Division, Johnston and air bases in Hawaii under Pacific Division.

*Contract Bases* are bases in foreign countries administered under contract by MATS Deputy Commander, Services. They are Ascension Island, Roberts Field, Monrovia (Liberia) and Keflavik Airport (Iceland).

*

This is a rough outline of the principal preoccupations of the US Military Air Transport Service. It does not by any means cover all the duties performed by the Service. Notably, it disregards the work carried out by MATS in the field of training personnel for its different branches ; the elaboration of its vast operating plans ; its detailed studies, in cooperation with civilian agencies, of suitable types of future aircraft ; its activity in testing and evaluating existing equipment ; its participation in actual design and development work.

MATS, which carries on its multitudinous duties with only about 50,000 officers and men, assisted by approximately 10,000 civilian employees and labourers, has every reason to be proud of its achievements. Twice within two-and-a-half years it has made a decisive contribution to the Western World's successful endeavour to call the Red Bear's bluff. In doing so, it has provided the American forces and those of the other Western nations with a tremendous amount of "know-how" for future occasions—as well as with a lesson. The lesson is that global strategy and military commitments can no longer be undertaken without an efficient military air transport organization, the larger and more efficient the better. The Korean incident would have been considerably less costly in men and equipment if MATS had been twice as large. And it would have *had* to be twice as large to win both in Berlin and Korea if the two had happened at the same time.

Boeing C-97 "Stratofreighters" are doing yeoman service in the carriage of cargo from the US to the Far East.

# The Fairchild XC-120 "Packplane"

The Fairchild XC-120 "Packplane," the latest addition to the famous line of "Packet" military aircraft, took to the air on its maiden flight on August 11th of this year, initiating a new approach to the myriad problems of air cargo transportation. In this revolutionary craft Armand J. Thieblot, Chief Engineer of the Fairchild Airplane Division, has melded the trailer truck with the airplane in one of the most practical ideas in modern air transportation history—the airplane that leaves its fuselage behind.

Among the many problems that face those concerned in the air transportation of military cargo, is the inevitable delay in loading and unloading which exposes a very expensive and inexpendable aircraft to enemy action while on the ground. In airhead operations, turn around time is excessive, calling for great numbers of aircraft, and a staggering amount of personnel for the loading and unloading operations in the airhead area.

Although he had been able to increase the load capacity and speeds of his "Packets," Armand Thieblot had conceived an entirely different idea for a universal air transport craft, and in March, 1948, the Air Force announced that the Fairchild Aircraft Division had received a contract for the development of a detachable fuselage aircraft. In just 17 months the actual detailed development and engineering, including construction and preliminary testing were completed, and on June 21, 1950, the Fairchild XC-120 "Packplane" was rolled out of the plant ready for the Air Force tests.

Armand J. Thieblot, "father" of the detachable fuselage concept, was born in France 46 years ago. He has been designing airplanes for nearly 25 years, and at one time was chief of stress analysis for the Fokker Aircraft Corp. in the US. In 1932 he joined the Fairchild Aircraft Division and has been responsible for the design of such widely accepted airplanes as the PT-19 primary trainer, the AT-21 twin-engine advanced trainer, the F-24 personal plane, the new T-31 Trainer, and the family of Fairchild "Packets."

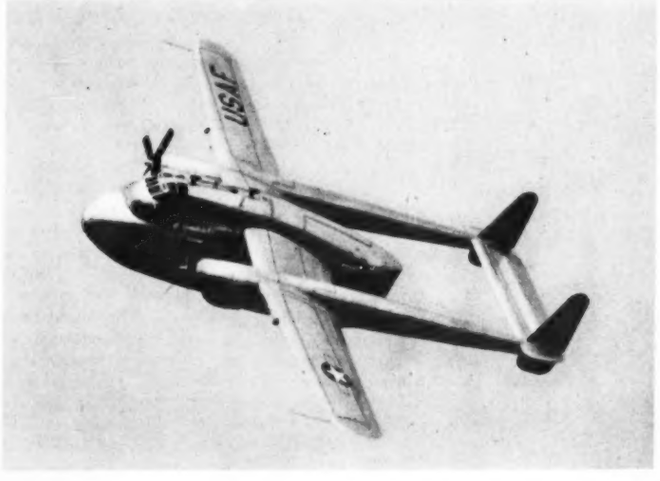
At first glance, the "Packplane" takes on the general appearance of its twin-tailed predecessors, the C-82 and C-119 "Packets," which are accepted as the standard post-war troop and cargo carrying transports of the military services, and are even now seeing active service in the Korean area. However, the basic difference between the "Packplane" and all other cargo carriers, is that it is composed of two individual units ; namely, the flight component which comprises wings, tail, engines, crew quarters, and everything necessary for flight, and the detachable fuselage "pack" or "pod" as it is also called, in which all cargo is carried.

Here, then, is the material outcome of Thieblot's basic idea, an airplane that can deposit its cargo compartment (or compartment for 36 stretcher cases) at an airport and fly off again to pick up another pack or pod just as the truck tractor picks up and deposits its loaded trailer unit.

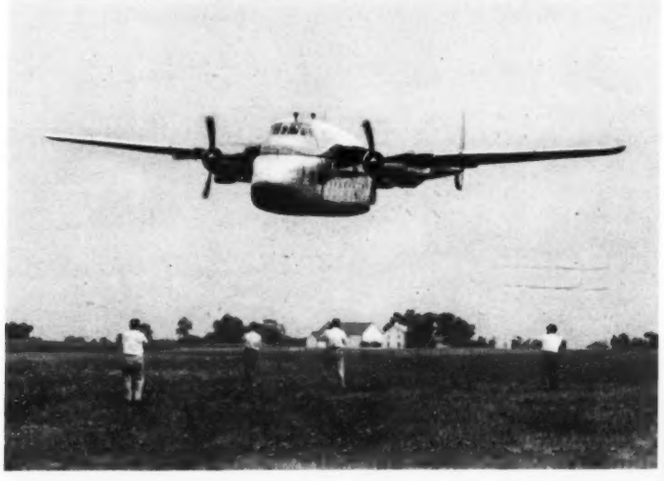
The cargo compartment of the XC-120 has been kept as closely to the shape of a box as possible. It is rectangular in cross-section as well as in floor plan, in order to facilitate the stowage of a great variety of cargo. The height of the floor above the ground is about four feet, and the attitude of the plane at rest results in a level floor throughout the entire compartment. Two huge clamshell doors are located at each end of the pack permitting cargo to be loaded at either end, and crew entrance doors are located in each of these door halves.

For ground handling of the pack, there are four dual wheel units which can be attached to fittings before the pack is lowered to the ground. These wheels are carried in the pack during flight. The front wheels have a full swivel for steering, while the rear wheels are fixed. Towing of the pod is accomplished

In spite of its bulk the prototype XC-120 "Packplane" can make quite a sharp turn.




High speed flight near the ground.



Landing on a narrow runway.

by attaching a tow bar to fittings on either of the front wheel units. The design of the plane is such that the pod may be brought in under the tail or wings with considerable clearance.

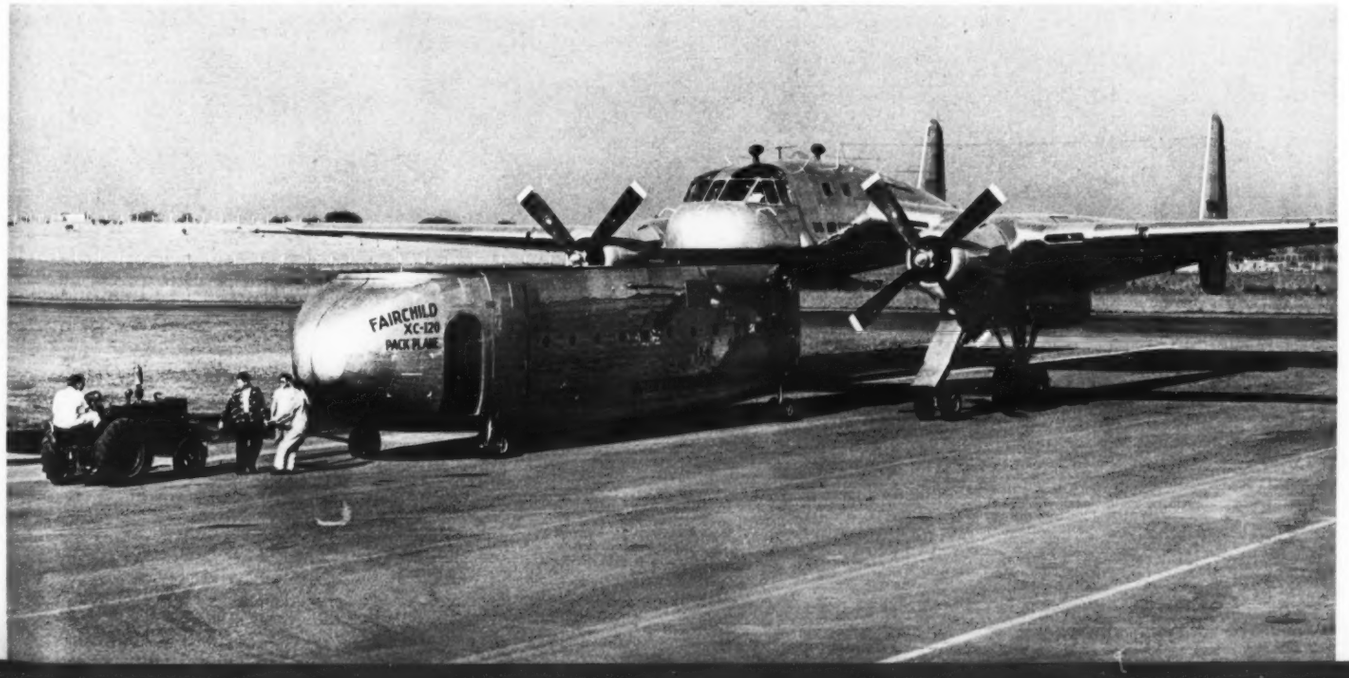
Four electrically operated drum hoists are built into the carrier for raising and lowering the pack, and the attachment fittings on the pack are within easy reach from ground level. Raising or lowering of the pack may be accomplished either in the crew nacelle or from outside the ship through a small hand-held portable control box attached by a wire to the plane. A rubber tube, stretched around the perimeter of the top of the pack, seals the space where the carrier and pack are joined. Air pumped into this tube expands it to provide a tight connection.

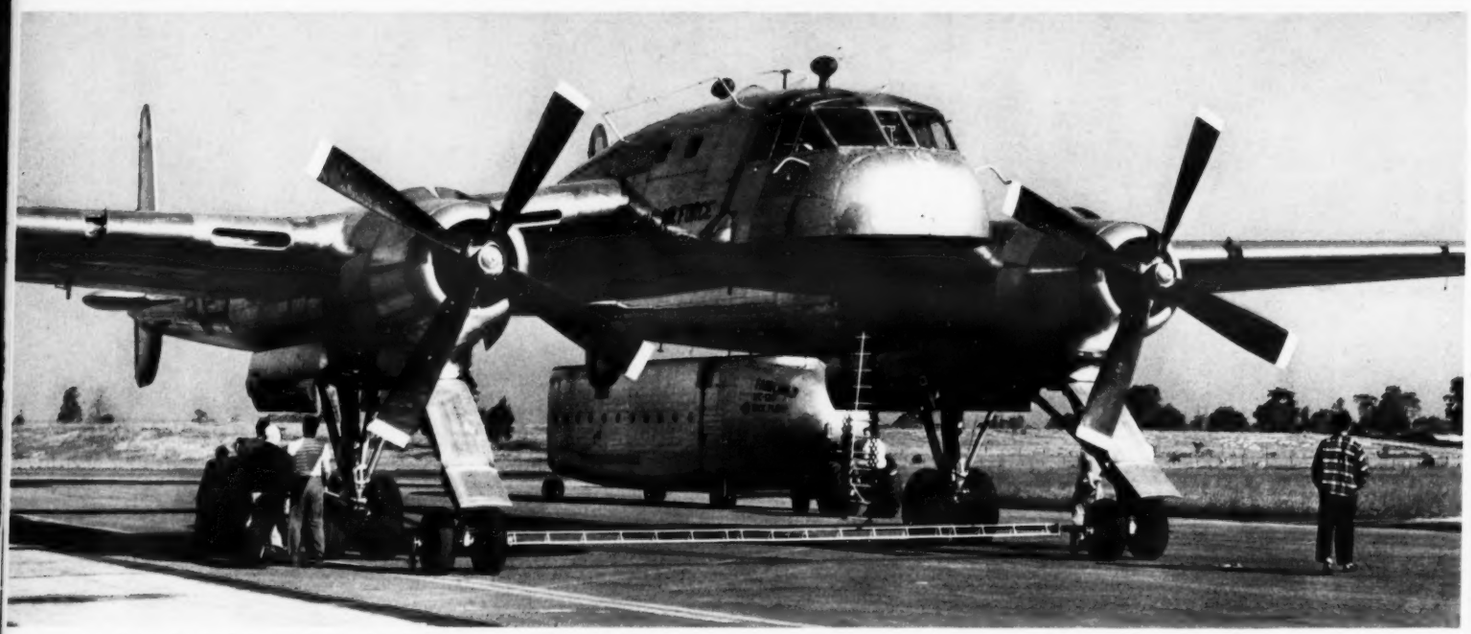
The wings of the flight component are of all-metal, full cantilever construction, and are composed of a centre section and two outer panels. The centre section, having negative dihedral, extends between the two engine nacelles, and mounted in the centre is the crew nacelle. The outer panels attach to the centre section at the outboard sides of the engine nacelles and are removable for repair or replacement. Four ailerons provide lateral control. There are two on each wing constructed as separate units and rigidly interconnected. A controllable trim tab is installed in the starboard aileron centre of span at the trailing edge.

The crew compartment has accommodations in the forward section for pilot, copilot, radio operator, navigator and crew chief. Access to this compartment is provided by a hatch in the floor and a ladder in the cargo compartment. With the pod removed, the crew uses a portable collapsible ladder that is stored in the crew nacelle when not in use. An overhead hatch with built-in window is installed in the forward section and opens outward. Both hatches are provided with internal and external releases and can be used as emergency exits. A crawlway connects the forward and aft portions of the crew nacelle, and two additional hatches with internal and external releases are located in the aft section.

The unusual quadricycle landing gear consists of four retractable dual wheel units. Electrically operated, they retract completely

The pack on its wheels being towed away by a tractor.





Before the pack is towed away wheel units are attached front and rear.

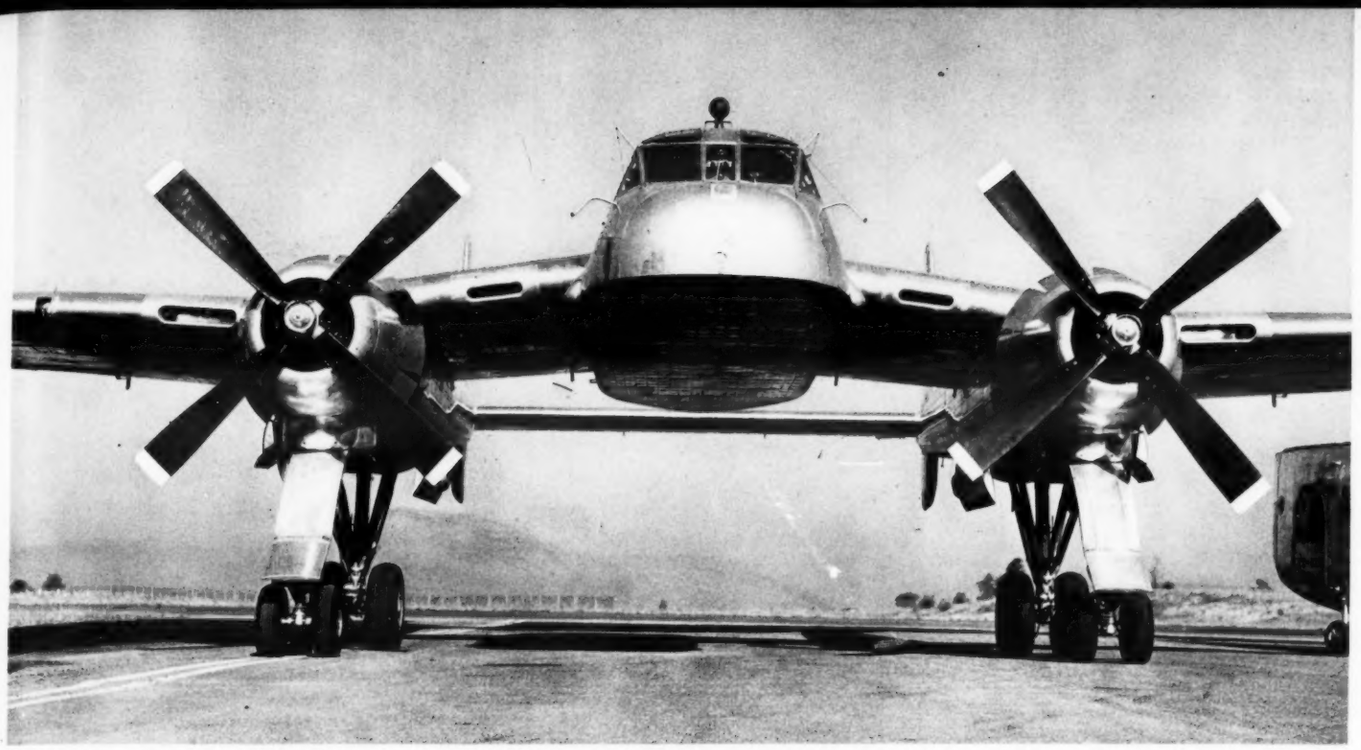
into the engine nacelles. The auxiliary wheel units (forward of the main wheels) are interconnected to the main gear by a mechanical linkage and retract simultaneously. The auxiliary wheels are free-rolling and steerable through a differential hydraulic system and controlled by the pilot through a small hand wheel. The main gear is fixed directionally and contains the hydraulic brakes. In an emergency, the clutch at the electric actuators is released permitting the gear to "fall free" into the down position.

The typically "Packet" tail booms are built in two separate sections, a forward boom and aft tail cone. The cross sections of the entire boom are elliptical and the construction is semi-monocoque with pressed frame and hat section stringers. They support the empennage surfaces and contain the rudder, elevator, tabs and surface lock control cables, de-icer heating ducts and electrical wiring.

Already extensive research has been done on possible uses of the "Packplane." One of the most active programs is the work being done by the combined medical unit under the Office of Defense at Fort Totten, New York. Here, every piece of medical equipment used by the field surgeon is being lightened, from the hospital bed to the scalpel. Folding equipment of lighter metals and tools of light weight material and efficient design are being made to insure totally air-transportable medical units for these new military concepts.

Also envisioned are packs that are built as special portable units such as photo laboratories, operating rooms and medical evacuation units, fully equipped machine shops, weather stations and GCA units. Packs that can be dropped by parachute will be the next step, for even now C-82 and C-119 "Packets" flown without cargo doors can drop six-ton howitzers. The "Packplane" could carry droppable boats for air rescue service, droppable landing barges filled with the equipment for beach head operations, theatre signal units

Clam-shell doors at each end of the pack facilitate loading and unloading.



Nose and tail are high above the ground.

for communications centres in inaccessible places, droppable shelters for Arctic rescue work, complete with clothing, food, heaters, etc. The transportation and storage of fuel, literal "flying tank cars," in which the fuel remains in the pack for storage after it has been flown to an airfield, is another application. Small tanks could even be carried aloft on short hops. The number of possibilities seems to be endless. Although at present the "Packplane" is a military instrument, its many implications are being closely studied by the civilian air transport companies for adaptation to commercial work.

The expensive part of a plane is the operational part—wings, engines, gas tanks, control surfaces, and all the many devices that are required for flight. The detachable fuselage, made of non-strategic materials, can be separated from the plane in only ten minutes, allowing the plane to fly away in the case of an attack, limiting the potential damage to the relatively inexpensive fuselage compartments. In short, the droppable fuselage, whether air landed or parachuted, provides the same service that the glider did in the last war.

"Large scale air transport of combat troops from the United States to Europe would have to be employed to hold a bridgehead on the European continent if western Europe were threatened by an invader. Unless airborne troops were flown from the United States, we might run the risk of losing our foothold on that continent." This assessment of the importance of airborne operations by Maj. Gen. Joseph M. Swing, former Commanding General of the Fort Sill Artillery Centre and wartime Commander of the famed 11th Airborne Division, gives added emphasis to the problem of providing efficient, flexible transportation and ground handling for troops, supplies, operating units, etc. The answer to the problem might well be the Fairchild "Packplane," which is capable of carrying between 44 and 64 troops.

When the pack has been removed the cabin is entered by means of a portable collapsible ladder.

Without its load the Packplane has almost the characteristics of a fighter.

### *SPECIFICATIONS*

| | |
|---|---|
| Design Gross Weight | 64,000 lbs. (29,000 kg) |
| Maximum Speed | over 250 m.p.h. (400 km/h +) |
| Altitude | 18,000 ft. (5,500 m) |
| Service Ceiling-Two Engines | over 25,000 ft. |
| Cargo Capacity | 2,700 cubic ft.<br>36 stretcher cases, or<br>20,000 lbs. cargo (9,070 kg) |
| Engines | Two Pratt & Whitney R-4360 of 3250 h.p. each. |
| Propellers | Hamilton Standard 15 ft. diameter blades. |

### *DIMENSIONS*

| | |
|---|---|
| Span | 109.3 ft. (33.3 m) |
| Length | 83.0 ft. (25.3 m) |
| Height | 24.9 ft. (7.6 m) |
| Cargo Compartment : | |
| Height | 8.0 ft. (2.45 m) |
| Width | 9' 2"-9' 8" (2.80-2.95 m) |
| Length | 36' 9" (11.20 m) |
| Area of cargo floor | 353 sq.ft. (32.80 m²) |
| Cargo capacity | 2700 cu.ft. (76.5 m³) |

# The Delegate from Lichtenburg

BY ***

*A friend of ours, who for many years was active at the hub of international aviation and has taken part in most of the conferences since the war, writes in ironical vein of ICAO's last General Meeting. Some of his comments may be slightly exaggerated and others perhaps a trifle one-sided, but on the whole he gives us much food for thought. After all, why should we always take things so seriously?*

The Delegate from Lichtenburg was properly impressed with the bright new home the Canadian Government had built for the International Civil Aviation Organisation. It did not have the baroque splendour of other and older landmarks of man's progress in international harmonizing. Not like the headquarters in Paris of the International Commission for Air Navigation, for example, where that predominantly Old World group, with measured and meticulous pace, had guided the first halting steps of infant aviation.

Nor was it exactly like the Palais des Nations in Geneva, where feuding mankind had unsuccessfully sought to patch up their quarrels. There was no *Lac Léman*, a jewel set in the heart of towering mountains, to lull the antagonisms that roiled in man's breast; only the purposeful St. Lawrence churned by freight-laden vessels and squat tankers. There were no preening peacocks; only gregarious pigeons profaning the marble head of Canada's Father of Confederation in Dominion Square. But, if the setting were new and different, so was aviation itself. It was the custom before the latest debacle engulfed Europe, the Delegate reminisced, for the representatives of Governments to undertake widely diverse assignments. Not as today when delegations were comprised of earnest young men from technical schools, crammed with precise knowledge and a uni-lateral determination to reach some immediate objective.

*

The Delegate told the smiling girl at the reception desk his name (surname first, Christian names last, if he had been a Christian), why he had come and, suitably identified, felt like Babbitt (if he had known that North American character). Then he marched off to the opening ceremonies.

The Delegate from Lichtenburg noted with professional satisfaction that the physical arrangements for the Fourth Assembly were immeasurably better than hitherto. Gone were the mechanical breakdowns, the hesitant consecutive interpretation, and the missing hotel reservations. And gone, too, were some of the first frenzied band that had staffed the initial attempts to keep together the moving parts of an assembly. But in Lichtenburg they have a saying that curiosity has retarded many a cat's social improvement...

Typical ICAO delegates: the President speaks Chinese.

He felt slightly uneasy when the Temporary Chairman launched the opening ceremonies. He had not, he recalled, given the documentation bulging in his case the attention it required for a conscientious appreciation of the agenda. And he did not have instructions from his Government to cover all possible contingencies. True, the Foreign Office had received all the monumental output of the ICAO presses, but the means of noting, sifting and analysing their prodigious wordage was lacking. The papers, he believed, were stored somewhere on the third floor of the Liberation Building. The Chief had promised that one day they would second a clerk from the Justice Department library to file the whole pile. It was doubtful whether even carefully classified documents would help much; there was none in Lichtenburgese. The Delegate put aside these disturbing thoughts and settled back as comfortably as he could for the opening speeches.

The Temporary Chairman solemnly declared the meeting open, announced that 37 of the 58 states belonging to ICAO were present, "a testimonial to the interest that its (ICAO's) work has aroused throughout the world." The Delegate calculated that this was about 65 per cent of total membership and wondered whether it really was such a striking testimonial.

The Canadian Minister of Transport described the delight with which his Government had greeted the completion of a new, shiny temple for ICAO, some five years after it had taken up residence in Canada.

The Premier of the Province regretted his inability to attend the opening session, and the ebullient, portly Mayor of the City, whose public life had been forcibly suspended by the Federal authority during the war for inciting young Canadians not to rally to the colours of their country, said that Montreal was "now on the march in all branches of transport."

Then, the Delegates were given the chance to declare their hopes and aspirations for ICAO. When the President came to "L" the Delegate mounted the rostrum to say that Lichtenburg, which begins with "L," was deeply appreciative of the fine contribution ICAO was making to international aviation and friendship. Because the Chief hadn't given any further instructions he sat down in the solitary seat fronted with an impressive shield lettered "Lichtenburg." There was a polite ripple of applause.

Finally, the opening ceremonies ground to their conclusion and officialdom cleared the decks for the business at hand. There were some difficulties ahead, the Delegate thought: four Commissions to cover, as well as higher level groups, and one man to do the covering. He cast about for the Commission most likely to provide sufficient latitude for his talents and, at the same time, a satisfactory lineage in the minutes to show the Chief. The Neighbouring Delegate was helpful; he was a Council member. "Attend the administrative commission," he counselled in purely non-aeronautical language. "You can say more and know less there than in most commissions. You might also observe that there isn't much left to discuss in the other Commissions. The Council has pretty well cooked the material for Assembly digestion, or, as we say, has harmonized technical dissonances."

From past experience, the Delegate knew that he would have to make up another deficiency in his armament. There was no Lichtenburger in the Secretariat to provide him with the intelligence necessary for an impartial appreciation of the Organization's temper. He found, as always, that the Secretariat was disarmingly frank in discussions with delegates. At the official reception (euphemism for the North American custom of discharging one's social obligations en

The Delegates are overloaded with work.

masse in the form of a cocktail party), the Chief, Section of Standardisation of Standards (CSSS), an early comer to aviation and (P)ICAO, discussed the difficulties of an international civil servant.

"Working conditions," he declared, helping himself to another cocktail and canape, "are indescribably bad." Then, he went on to describe how bad they were. "Morale is plumbing new depths of red tape and frustration. There is an appalling lack of good faith, and an even greater absence of wise and courageous leadership. The Secretary General does not possess the loyalty of his staff, or the confidence of the Council. The President maintains the right of intervention into Secretariat matters without responsibility for its direction."

The Delegate of Lichtenburg suggested that things really couldn't be that bad. The CSSS said they were, indeed, and if at any time the Delegate sought information, he would be happy to reserve his time for imparting it. For example, the problem of salary disparities between ICAO and the United Nations, the lack of organized cultural activity in Montreal, or the complete lack of respect North Americans held for civil servants were matters that moved him deeply...

The Delegate spied the Neighbouring Delegate surrounded by a group of Secretariat, which, he gathered from the rising notes of laughter was engrossed on matters of a non-aeronautical nature. He shuffled off in the direction of the group.

*

Not a ripple of the CSSS's discontent was mirrored in the reports studied by the administrative commission. National representation on the Secretariat was being widened steadily, the Delegates were told. The Neighbouring Delegate said that such was the case but pointed out that 75 per cent of the top secretariat had English as their mother tongue. And many nations represented on the Secretariat were represented by nationals holding lowly posts.

The little and non-Council states were not blameless in all this, the Neighbouring Delegate said. Only twenty states sought to fill the twenty-one vacant Council seats at the elections this year. If the big powers dominated the Organization, and the Council in particular, it was the fault of all members. In fact, one must always remember that the Organization was only as good as the will of all its members to see it work effectively. If the small nations felt that in the final analysis the Organization was a cartel of Anglo-Saxon nations they had the opportunity to break up that domination.

The Delegate asked the Neighbouring Delegate if, despite these disparities, he regarded the progress of the Organization as a whole as satisfactory.

The Neighbouring Delegate said yes and no. Certainly, he said, the agenda for the Fourth Assembly did not indicate much progress in the non-technical fields, wherein lay the most difficult tasks ahead of ICAO. Achievement in the air transport field would be the most pungent talking point for its existence. In the air navigation field, in the provision of facilities for air navigation, progress had been substantial. But it must be remembered that ICAO did not pioneer the creation of standards ; there was a modest, inexpensive and effective predecessor organization, called the International Commission for Air Navigation, which created a workable set of standards a long time ago.

The Neighbouring Delegate said he was not alone in his dissatisfaction with ICAO's air transport activities. He pointed to the minutes of the Economic Commission in which the Representative of France stated :

"The technical staff of the Secretariat, he thought, should be recruited, at least in part, by secondment of officers from member states so as to ensure a certain measure of rotation ; second, the secretariat of the Organization included too large a number of officials in administrative posts with a knowledge of only one language ; and third, it was highly desirable that ICAO should devote serious study to the problem of ending economic waste caused in international civil aviation by irrational competition. The Representative of France wished to know whether it might not be preferable and easier, since ICAO's chief aim was to improve co-ordination in civil aviation on a world-wide basis, *to attempt first to bring about improved co-ordination on a regional basis in order to secure tangible results.*"

Further :

"The Representative of France agreed that technical co-ordination should be considered on a world-wide scale but he regretted that disorder was still prevalent as regards co-ordination of commercial services and that this situation made profitable operation impossible. He felt that ICAO had been entrusted with the task of helping to improve the operation of air services as provided by Articles 55 (a) of its Convention, which stated that ICAO should co-operate in the organisation of air transport on a regional basis. He considered that it would be desirable first for ICAO to bring about better co-ordination on a regional scale to secure practial results.

...The trouble with the air transport programme, the Neighbouring Delegate said, was that the Organization is still pecking away piecemeal at air transport problems rather than working to a master plan evolved from the Convention. The Secretariat has not provided the initiative, imagination or creativeness necessary to

"A testimonial to the interest that ICAO's work has aroused throughout the world . . ."

give the Council guidance, which, for the most part, does not possess specialized knowledge on the subject. The Organization has, in consequence, embarked upon a programme which, although permissible under the Convention, ignores its compulsory responsibilities. For example, there has been no examination of the costs of operation or the extent of subsidies of air transport, specifically mentioned by the Convention. There have been no studies on the progress of air navigation and the operation of international air services to determine whether or not the demand for these services is being met regionally. No extensive efforts have been made by the Secretariat to amass the data necessary for the formulation of a pattern for an agreement on the exchange of commercial rights.

While many important air transport problems were being ignored, the Delegate said, a high proportion of the time of Council and Secretariat was being lavished on fiddling details of finance, personnel and internal arrangements.

Admittedly, there were some domestic difficulties that must be solved before the Organization could move toward its responsibilities. The Council must build up a sound, efficient Secretariat under wise and courageous leadership, then clear out.

*

While the Assembly failed to get at the heart of these domestic difficulties, it moved with enthusiasm to excise a large $250,000 (Canadian) from the budget put forth by Council. And it did so without reference to the works programme for 1951. Either the states that voted for the reduction considered that the costs of operating ICAO were excessive and were to be reduced regardless of results obtained, or the results themselves were insufficient to warrant expenditure of the amount asked. Carried along by general sentiment in favour of the reduction, the Delegate voted for the motion.

Were the results, in fact, so much greater than those of the modest International Commission for Air Navigation, he asked himself. Had ICAO's achievements in the air transport field, which had not been included in ICAN's terms of reference, justified the vastly greater outlay of men and money ? He recalled that the least that could be said for it was that Paris was a more agreeable climate for international meetings. But international organisations of the air were now 30 years of age and this was one of the most perplexed eras in man's woeful history. The Delegate didn't think it mattered much one way or the other, except to the Secretariat.

At the final plenary meeting the Delegate ticked off the resolutions patiently as they were pushed through in last-moment haste. When the last one was moved and voted all agreed that much valuable work had been done. The Delegate snapped shut his case and prepared to return to Lichtenburg to report to the Chief. He must remember to get that clerk filing the documents on the third floor of the Liberation Building.

An ICAO Committee : Delegates hang on the speakers' every word.

# Book Reviews

*Jane's All the World's Aircraft, 1950-51,* compiled and edited by Leonard Bridgman. — Published by Sampson Low, Marston & Co, Ltd., London.

Jane's annual, which can scarcely be surpassed for comprehensiveness, needs no recommendation. Its name speaks for itself. As in earlier years, it contains a comprehensive and systematic description of flying material, aircraft industry, air transport companies, military aviation, international and national organisations, etc. This can, of course, be done with complete reliability only for the countries this side of the Iron Curtain. However, the new Jane's takes part with skill in the guessing game about the Red Air Force's newest jet fighters and bombers, and gives interesting particulars of Czech and Polish aircraft types. *Ba.*
(English.)

*The Pratt & Whitney Aircraft Story.* — Published by Pratt & Whitney: Aircraft Division of United Aircraft Corporation, August 1950.

To mark Pratt & Whitney's Silver Jubilee, *Interavia* recently published a short article outlining in brief the most important steps on Pratt & Whitney's road to international fame. (*Interavia*—Review of World Aviation, No. 8/9, 1950.) In the present book the Company itself has brought out a masterpiece whose text and illustrations lift it out of the realm of "publicity" and make of it a chapter in American aviation history, or rather in aviation history in general. (English.) *He.*

*La Commande Hydraulique.* — By C.-R. Himmler. — Dunod, Paris, 1950.

It has been found that all control problems can be solved equally well by means of hydraulic as by electrical systems.

The decision to use one system or the other is nearly always an arbitrary one. Electro-technical advances and the development of methods of amplification have frequently led to the use of electrical systems where they were not essential. On the other hand, such progress has been made in hydraulics that it is now possible to produce hydraulic control systems which, while having the same power, are only one tenth as heavy as electrical systems. This book by M. Himmler, who has worked for Siemens Halske and at the German Aeronautical Research Institute, is therefore very timely. The author has set out to describe the present stage of development of hydraulic control systems, and to expound the fundamental laws and their applications. *La Commande Hydraulique* is thus a veritable treatise which, in view of its wide subject matter (theory, description of equipment—pumps, motors, torque converters, distributors, regulators, etc.) will be a valuable guide to the engineer and the student who has to study the uses of hydraulic transmissions. We should also like to comment on the clarity of the diagrams and the quality of the drawings and sections of the various apparatus shown.
(French.) *Rh.*

*The Conquest of Space.* — By Chesley Bonestell (paintings) and Willy Ley (text). — Published by The Viking Press, New York, and Sidgwick & Jackson, London, 1950.

Coloured pictures of other worlds within our solar system, of distant *Saturn* with its ring and satellites, of the nearer planet *Jupiter* and its surface of lava, ammonia, ice... and flames, of red-green *Mars* looking positively idyllic by comparison, of the inner (red-hot) planets *Mercury* and *Venus,* and above all of our nearby *moon,* grip the reader's imagination. One would think they had been taken with the colour camera of a planet explorer! Black and white pictures of rocket flights high above the earth and the moon, and of the outermost planets Uranus, Neptune, Pluto, bring the number of illustrations, most of them full-page, up to nearly 60. These pictures are by the painter-astronomer Chesley Bonestell. They are not merely artist's impressions, but are based on sober calculations of relative sizes with given angle of sight and known distance, on equally sober estimation of colours resulting from spectral (and other) examinations of the planets' surfaces. Bonestell has been able to produce convincing pictures of what Saturn, for example, looks like from one of its nine (or is it ten ?) moons, or Mars from its satellite Deimos, our own moon from a rocket flying 10 miles above it, etc. When the pictures were finished famous astronomers checked the trueness of their colours and other details.

To accompany these paintings the well-known rocket expert and space travel enthusiast Willy Ley (cf. "Shape of Ships to Come" in *Interavia* No. 10, 1950) has written a simple introduction to the principles of this "Conquest of Space." Terms such as "mass ratio," "Brennschluss speed," the ellipse as the general form of orbits in space with "apogee" and "perigee," and special forms such as parabola and circular orbits, are clearly explained, and the moon and its surface described in meticulous detail. The text is supplemented by a brief table of the planets, not forgetting the moons of the various members of the solar system and the numberless planetoids.—A really gripping book which deserves the widest possible circulation! *Ri.*
(English.)

*Technologisches Wörterbuch.* — By Kurt Stellhorn. — Published by W. Girardet, Essen, 1950.

Really good technical reference books for foreign languages are few and far between. The present dictionary of metallurgy, and iron, steel and metal-working terms (with special reference to machinery) is above the average in every respect. Over 20,000 technical expressions in German and French are collected here, and special attention has been paid to accuracy in translation. *Ba.*
(German-French and French-German.)

*Le Droit de Voler* (The Right to Fly). — By John C. Cooper; French edition translated by Charles Roland-Gosselin with an introduction by Albert de La Pradelle. — Published by Les Editions Internationales, Paris, 1950.

Our opinion of this book by the well-known air law expert, John C. Cooper, has not changed since 1947 (cf. *Interavia*—Review of World Aviation—No. 10, 1947). It provides the *indispensable definition of the basic terms* (air power, ability to fly, right to fly, sovereignty, etc.) without which any study of air law must be incomplete.—The high standard of the translation is vouched for by the fact that a scholar of the eminence of La Pradelle has written the introduction. *He.*
(French.)

*Voraussetzungen und Umfang der Luftbaftpflicht gegenüber Drittpersonen.* — By Peter von der Mühl. — Published by Helbing & Lichtenhahn, Basle 1950.

Like the Warsaw Convention of 1929, which deals with the contractual liability of the air transport operator with regard to the passenger, so too the Rome Convention of 1933, which lays down the compensation to be paid for damage suffered by third parties on the ground, is about to be revised—a revision necessitated by the increase in traffic. In the redrafting of both international agreements discussion is centering chiefly around the question of how far the liability of the carrier or the aircraft operator should be founded on the principle of guilt, or how far it should be based, irrespective of any question of guilt, on "increased risk" due to the operation of an aircraft. Shall it be permitted that a limit be placed on the amount of compensation for which an operator is liable, or shall carriers or operators be liable to an unlimited extent to the injured party? The present paper, which examines the question of liability towards third persons on the ground (Rome Convention), was originally written as a thesis for the University of Basle in 1947. To a certain degree its original purpose is still to be seen in the present revision, in that the author is reluctant to go beyond the bounds of Swiss air law. On the other hand the paper profits from the practice, common in the writing of theses, of going back over the historical development (the laws of Hammurabis as the source of modern air law!).

And finally countries other than Switzerland receive some consideration, in that foreign verdicts and literature are cited.

*Le Transport Aérien.* — By F. C. Haus. — Extract from issue No. 3, 1949, and Nos. 1, 2 and 41, 1950, of the "Annales de l'Association des Ingénieurs sortis des Ecoles spéciales de Gand."

This paper sets out to give as objective an outline as possible of the present position in commercial aviation and to compare its intrinsic qualities with those of ground and sea transport. The author, a professor at Ghent University, first of all describes the present situation in air transport, on the basis of statistics, then examines the characteristics of aircraft, airports, control, crews, safety, financial returns (by the method used by the Air Transport Association of America), regularity and comfort. Finally he draws certain conclusions and devotes a few lines to seaplanes, helicopters, flight refuelling, assisted take-offs, etc. All this is accompanied by numerical examples based on statistics. *Le Transport Aérien* is thus an objective and considered study of commercial aviation, which does not pretend to go into details, but which is nevertheless complete. *Rh.*
(French.)

*The World's Airways and How they Work.* — By Captain G. James, John Stroud and others. Introduction by Sir William P. Hildred. — Published by Odham's Press Ltd., London 1950.

In our harassed age of diplomatic notes and international incidents men have hit upon worse ideas than these British transport pilots and aviation journalists, who have banded together to bring to the notice of the widest possible public an achievement of peace, namely world air transport. John Stroud, B. J. Hurren and other well-known writers have produced an illustrated introduction to air transport (planning of routes, policies as regards material, air safety, weather service, control of air traffic etc.), which is readily understandable to the man in the street and may win the support of youth for the great objectives of international civil aviation. And that is no mean achievement!

## *Books Received*

(To be reviewed later.)

*Taming the North.* — By Hudson Fysh. — Published by Angus and Robertson, Sydney and London.

*The Complete Book of Motor-Cars, Railways, Ships and Aeroplanes.* — By F. Ferneyhough, A. V. Clifford, R. E. Dean, F. R. Morley, Frank C. Bowen and W. N. S. Bevan. — Published by Odhams Press Ltd., London.

*Einführung in die Technische Thermodynamik.* — By Dr. Ing. Ernst Schmidt. — Published by Springer Verlag, Berlin-Göttingen-Heidelberg, 1950.

*L'Aeronautica Italiana nella IIa Guerra Mondiale.* — By Giuseppe Santore. — Published by Danesi, Rome, 1950.

*Publications scientifiques et techniques du Ministère de l'Air.* Distribution by the Service de documentation et d'information techniques de l'Aéronautique, Paris:

No. N. T. 35. *Le point astronomique simplifié dans les régions polaires.* — By P. Hugon.

No. N. T. 36. *Abrégé de la Théorie générale des séries divergentes,* known as *Théorie des séries définissables.* — By Pierre Vernotte.

No. 242. *Equations intégrales et transformations de Laplace.* — By Maurice Parodi.

No. 243. *Contribution à l'étude des différences en vue de l'application aux souffleries aérodynamiques subsoniques.* — By Raymond Gœthals.

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| Netherlands | Fl. 26.40 | M. van Gelderen & Zoon, Postbox 826, Amsterdam-C. |
| Belgium | Belg. frs. 320.00 | Interavia, 11, Rue de Crayer, Brussels, or Office de Publicité, 16, Rue Marcq, Brussels. |
| Denmark | Kr. 40.00 | Dansk Centralagentur, 20, Stormgade, Copenhagen. |
| Sweden | Kr. 30.00 | Interavia, Postbox 29, Linköping. |
| Norway | Kr. 40.00 | Narvesens Kioskompani A. S., Box 125, Oslo. |
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| Finland | | Akateeminen Kirjakauppa, 2 Keskuskatu, Helsinki, or Rautatiekirjakauppa Oy, 2 Köydenpunojank, Helsinki. |
| Canada | US $6.00 | Wm. Dawson Subscription Service Ltd., 60 Front Street, West, Toronto, Ontario. |
| South Africa | £2. 0s. 0d. | Interavia, P. O. Box 7063, Johannesburg. |

# Trial of Strength in Korea

## *Air Supremacy Tips the Balance*

BY MAJOR EDDY BAUER, NEUCHATEL

### *North Korea's Weakness in the Air*

When, with Seoul captured in a trice (28th June, 1950), the motorised columns of North Korea's General Kim Ir Sen were racing along the road to Taejon, there was only one cry among the supporters of military conservatism. "You see," they wrote, "the air force and particularly jet fighters are not capable of stopping tanks. To pin them down there is nothing better than the good old infantry." In jumping to this premature conclusion they lost sight of the fact that, during this first phase of operations in Korea, the infantry did not put up any better a show than the U.S. Air Force and that the meagre battalions of the 24th Infantry Division were no more fitted to repel the famous T 34 and T 44 tanks of the Communist Army than were the F-80 "*Shooting Stars*" of the U.S. Fifth Air Force. With such weak forces at its disposal—between 26th June and 10th July there was an average of only 104 sorties a day—the monarch of the skies was no more powerful than lesser mortals on the ground.

Now, three months later, although the American infantryman has well deserved the tribute paid to him by President Truman, it is clear beyond all doubt that the rout of the North Korean army, which but lately had carried all before it, can only be fully explained by the inferiority of its air forces and the increasingly overwhelming superiority of British and American air power. We can even go further and state categorically that if General Kim Ir Sen's *Yak 9's* had controlled the skies in his rear and protected it from all attacks beyond normal artillery range, Divine intervention would have been needed to enable General Walton H. Walker successfully to re-embark his 8th Army at Masan and Pusan. With a few formations of *Petlyakov PE 2* twin-engined light bombers or *Tupolev TB 7* four-engined medium bombers, there would not even have been a second Dunkirk.

*

According to Lt. Col. Cyrille Kalinov, the Pyong-Yang Government had not neglected to raise the question of a North Korean air force with the Soviet Military Mission which,

General George E. Stratemeyer, of the USAF, Commander of the United Nations air forces, was familiar with the Korean theatre of war.

under the orders of Generals Katiokov, Koreteyev and Zakharov, was engaged from the end of December, 1948, onwards in building up the army of aggression, and had even demanded the formation of four Air Fleets of 250 fighters and bombers each.[1] If this plan had been put into effect there would have been, on 25th June 1950, 1,000 aircraft marked with the Red Star, against less than 500 Americans. The Politburo, fearing apparently that a military instrument of such magnitude might tempt Dictator Kim Ir Sen to follow Tito's example, obstinately refused the reasoned requests which he repeatedly put before them. Thus he had to resign himself to crossing the 38th Parallel with about a hundred *Yak 9's,* rated "quite good" by his opponents, and about thirty medium bombers. This is what General George E. Stratemeyer, commander of the American Pacific Air Force, reported in his statement to the Press on 3rd October, 1950.

On 28th June the F-51 "*Mustang*" fighters sent by General MacArthur to the aid of President Syngman Rhee shot down six North Korean machines over Seoul. On 10th July a Tokyo communiqué estimated Red air losses at 24 aircraft. As August advanced, Communist air operations became more and more rare. Here a destroyer of the Royal Navy received a few bursts of machine-gun fire off Seoul ; there an American battalion was fired on from the air. But by 30th August General Kim Ir Sen's air forces had been reduced to fifteen fighters, and by 15th September, at

[1] Cf. *Curieux*, 24/8/50 : "I Saw the Formation of the North Korean Army," by Lt. Col. Cyrille Kalinov.

A formation of B-29 "Superfortresses" flying over enemy territory in Korea. Over 12,000 tons of bombs were dropped from B-29 bomb bays during the months of July and August alone.

the time of the Imchon landing and the airborne operation at Kimpo, it was noted that air fighting had ceased for lack of adversaries on the North Korean side.

What does this mean ? According to certain observers, the Kremlin failed to provide the aggressors of 25th June with air support in proportion to their ground forces, which appear to have been in the region of about twenty divisions[2], because it was convinced that the conflict would remain localised between the forces of Seoul and those of Pyong-Yang. We should not wish to quarrel with this opinion, which is plausible enough, but it will be remembered that in July, 1948, the Russians threw themselves lightheartedly into the sorry affair of the Berlin blockade, a step which showed a curious failure on their part to recognise the potentialities of the aircraft. By all the evidence the airlift organised by their opponents between the ex-capital and the British and American Zones of Occupation was a complete surprise to them. It might be that in Korea they have fallen into the same error of miscalculation.

However that may be, we must also point out the obvious weakness of the North Korean Army as far as anti-aircraft defences are concerned, equipped as it was with such widely known material as the 20 mm cannon. On 16th August 99 B-29 "*Superfortresses*" of the Fifth Air Force dropped 3960 500-lb. bombs in an area 8 by 3 miles on the right bank of the Naktong. Eye-witnesses of this operation saw the American four-engined aircraft manoeuvring undisturbed between 4500 ft. and 6000 ft. over the Waegwang sector, and we know that they all returned to their bases on Guam or Okinawa that day. True, there were a few machines shot down by ground fire, such as the "*Vought Corsair*" of the 77th Naval Air Squadron on 2nd October whose pilot was picked up by a Naval helicopter in the centre of the town of Pyong-Yang, but on the whole the losses sustained by the Allied air forces during three and a half months of operations have been extremely light. Up to 20th August, as far as the 5th Air Force was concerned, they were no more than 55 machines, viz :

1 *Boeing B-29* "*Superfortress*" heavy bomber,
6 *Douglas B-26* "*Invader*" light bombers,
3 *North American F-82* "*Twin Mustang*" all-weather fighters,
24 *North American F-51* "*Mustang*" fighters,
17 *Lockheed F-80* "*Shooting Star*" fighters,
2 reconnaissance aircraft,
2 *Douglas C-54* "*Skymaster*" transports.

On 4th October a dispatch from Washington published the USAF's casualty list. Up to that date the losses amounted to 179 officers, N.C.O.'s and men, viz :

54 killed or died of wounds,
37 wounded,
88 missing[3].

These figures are ridiculously small by comparison with the heavy sacrifices which have had to be made by the ground forces in order to achieve victory for the Stars and Stripes. The figures which we have before us give their losses up to the same date as over 17,500, including nearly 3000 killed and 4000 "missing"...

As for the passive defence of the North Korean lines of communication, an American dispatch of 29th August states that the North Koreans stretched steel cables above the roads to prevent hedge-hopping attacks. Indeed, several British and American fighter-bombers which have crashed under conditions for which their squadron comrades could find no explanation appear to have been victims of these tactics. Such was probably the fate of Squadron Leader L.T. Spence, commander of the "*Mustang*" squadron sent to the Korean front at the beginning of the conflict by the Australian Government.

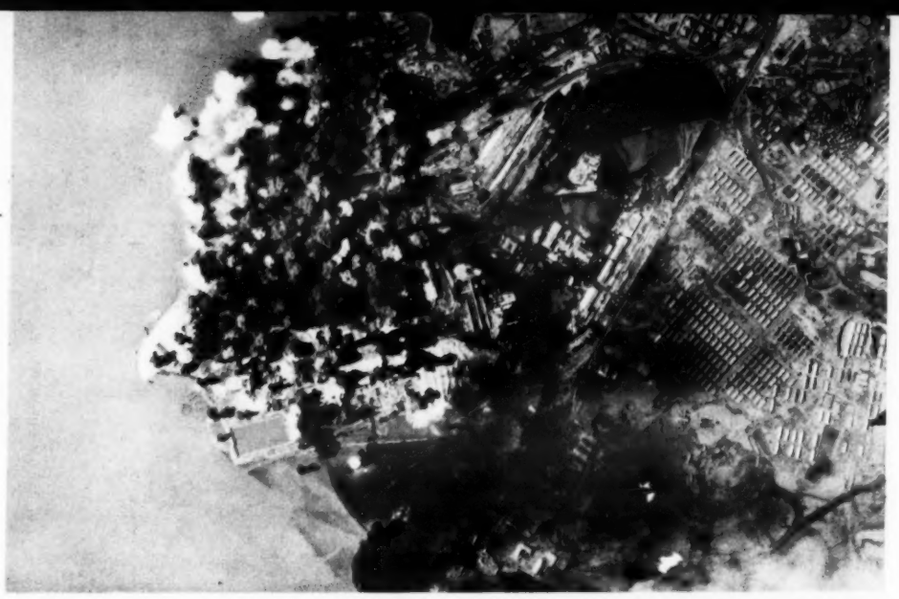
*The Anglo-American Reply.*

*Interavia* readers will pardon us if we review once more the strength of the American air forces in the Pacific between the Marianas and Japan on the day of the North Korean aggression. Altogether and for all purposes there were, as we wrote in July last[4], less than 500 machines, made up as follows :

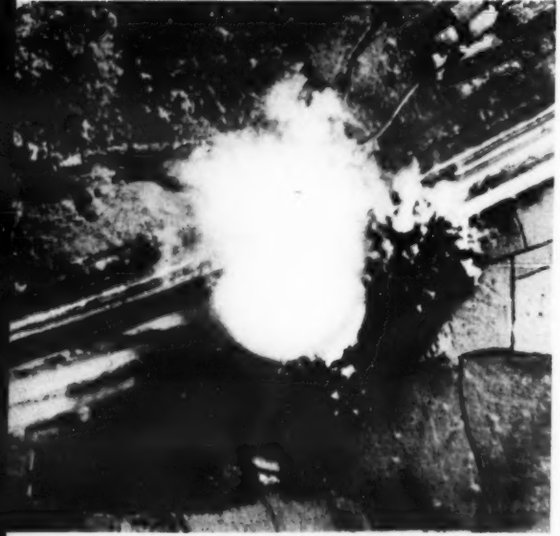
1 squadron of *Boeing B-29* "*Superfortresses*": 50 aircraft,
2 squadrons of *Douglas B-26* "*Invaders*": 32 aircraft,
1 squadron of *North American F-82* "*Twin Mustangs*": 24 to 36 aircraft,
5 squadrons of *Lockheed F-80* "*Shooting Stars*": 325 to 375 aircraft,

i.e., a minimum of 411 or a maximum of 473 combat planes, to which should be added a transport group equipped with four-engined *Douglas C-54 Skymasters.*

Events have shown that these modest forces were rapidly and considerably reinforced between the early days of July and the last days of August. Above all, on about 12th July 75 *B-29 Superfortresses* of the 22nd and 92nd heavy bomber groups went into operation in the Far Eastern theatre. A week later



More than 600 tons of bombs were dropped by B-29s on the industrial complex at Chinnampo, the port city of Pyong-Yang. This strategic target included a chemical plant, smelter, non-ferrous metals processing plant and marshalling yards.

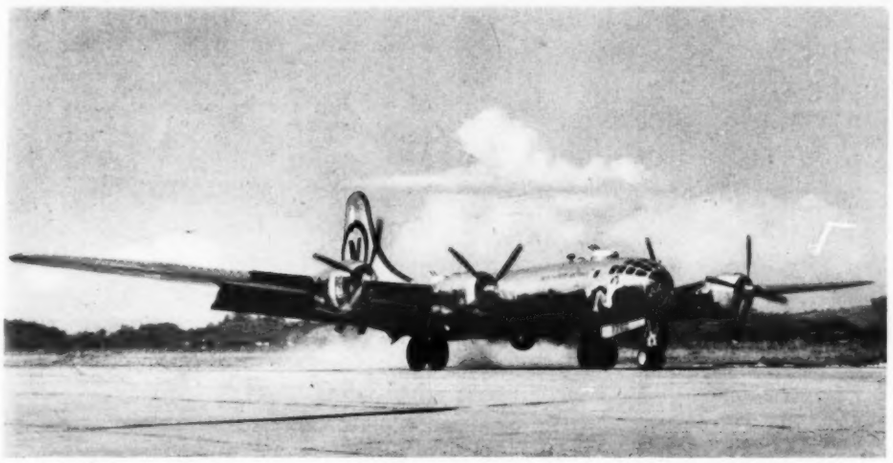


"Superfortresses" also undertook tactical bombing missions. This radio picture shows a moving North Korean ammunition train being blown sky-high between Sinanju and Pyong-Yang. A single B-29 made a precision-bombing attack with a stick of 500-lb. bombs.

[2] Two armoured divisions, 3 motorised divisions, 14 or 15 infantry divisions of the Soviet type.

[3] Out of a total strength of 53,054.

[4] Cf. "Korean Commentary," INTERAVIA, Review of World Aviation, No. 7, 1950. These figures, taken from the French press, seem to indicate that the American units in Japan were not up to strength.



One of Major-General Emmett O'Donnell's "Superfortresses" rolls down the runway of its base in Japan after returning from a mission over Korea.

the heavy aircraft carrier "*Boxer*," having crossed the Pacific in the record time of eight days and seven hours, dropped anchor at Yokohama with a full load of *F-51* "*Mustang*" fighters. After this date, the shroud of military secrecy covering the transfer of squadrons from one side of the Pacific to the other became increasingly impenetrable. However, there is no doubt that the American air forces in Korea were continuously strengthened up to about 1st September.

It is therefore not possible to give exact figures of the strength of the American air units which played the decisive part in the conflict between North and South Korea. Nevertheless, we have a few figures to go on. Between 26th June and 3rd October U.S. aircraft flew over 40,000 sorties and dropped 29,000 tons of bombs, which gives us a general average of 400 sorties a day. Now, between the commencement of hostilities and the 10th July this same daily average scarcely exceeded a hundred. Moreover, the Washington statement that 53,064 officers, N.C.O.'s and men of the USAF had taken part in the operations of this compaign enables us to make another estimate. It is well-known that about a hundred air crew and ground personnel are required to keep a "*Superfortress*" in the air and about fifty men to keep a fighter in operation. If we combine these various data, we arrive at a figure of some 1000 machines of all types, excluding of course, the liaison and observation aircraft attached to the large Army units, and the helicopters of the U.S. First Marine Division.

Lieutenant-General George E. Stratemeyer was in command of all these units, in his capacity of commander of the U.S. air forces in the Far East. It will be remembered that at the time of the capitulation of Japan (2/9/45), he was in command of the 10th and 14th American Air Forces in China under the orders of General Wedemeyer. He returned to General MacArthur's Staff in Japan in April, 1949, after commanding the USAF's Continental Air Command for some time. The Korean theatre of operations was therefore perfectly familiar to him. Under his command the strategic bomber squadrons were, and still are, led by Major-General Emmett O'Donnell, nicknamed "Rosie" by his crews, and the tactical support units by Major-General Partridge. This is exactly the same organisation which functioned so efficiently in the Far East between 6th June, 1944, and 8th May, 1945.

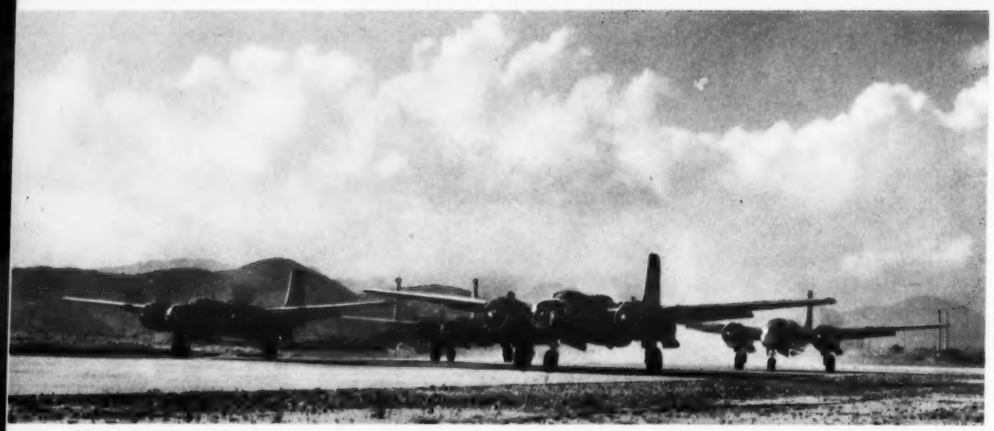
Rockets have proved their great destructive power against enemy armour in Korea. Illustrated is the scene at a U.N. air strip at which F-51 "Mustang" fighters of No. 77 Squadron, Royal Australian Air Force, are being prepared for a strike against the Communist forces. Rockets are of the smaller, 5-in. variety.

In recent weeks the allied forces have encountered practically no North Korean opposition in the air, apparently because the Russians have refused to place sufficient numbers of aircraft at the disposal of the Pyong-Yang Communists. The photo shows U.S. Marines uncovering a practically undamaged Russian-built Yak-9 fighter buried under pieces of roofing from a hangar at Kimpo aerodrome near Seoul.

*

But this is not all, for we must not underestimate the support given to the ground operations by the carrier-borne aircraft of the U.S. Seventh Fleet (Vice-Admiral Arthur Strubble) and the British Far Eastern Squadron (Vice-Admiral Patrick Brind), both under the command of the American Vice-Admiral Calvin E. Joy. The width of the Korean peninsula, between the Yellow Sea and the Sea of Japan, varies between 155 and 220 miles, so that it follows that all the targets, tactical or strategic, which it may contain are within the effective range of a modern aircraft carrier.

The 27,000-ton "Essex"-Class carrier "*Valley Forge*" was the only vessel of this category flying the Stars and Stripes in Japanese waters at the beginning of the conflict. Within a few weeks three other large aircraft carriers of 27,000 tons and 33 knots rallied to the flag of Vice-Admiral Joy, namely the



Tactical bombing operations, notably with "Napalm" phosphorus fire bombs, were the principal mission of the Douglas B-26 twin-engined attack bombers. These aircraft, a formation of which is shown taking off from their base in Japan, flew round-the-clock missions against the North Koreans.

"Essex"-Class carriers "*Boxer*," which we have already mentioned, the "*Philippine Sea*," and a third, probably the "*Leyte*." In addition, two 12,000-ton escort carriers, the "*Badoeng Strait*" and the "*Sicily*," have been mentioned as being in Korean waters. The British squadron under Vice-Admiral Brind originally comprised only the Light Fleet Carrier "*Triumph*" of 14,000 tons and 25 knots, of the so-called "Colossus"-Class, but by the beginning of September she had been joined by the "*Warrior*" and the "*Theseus*" of the same class. We should also note in this connection that the aircraft of the British Naval air service have at their disposal the aircraft maintenance ship "*Unicorn*" of 14,750 tons.

The ground forces of Generals Walker and Almond could therefore count upon the co-operation of the following :

| | | |
|---|---|---|
| 4 "*Essex*" Class | 27 fighters<br>37 bombers<br>18 torpedo-carrying aircraft<br>27 spare aircraft | |
| | 4×109 | = 436 machines |
| 2 *Escort* Carriers | 22 fighters<br>12 bombers | |
| | 2×34 | = 68 machines |
| 3 "*Colossus*" Class | 3×40 | = 120 machines |

This would give us 624 machines, from which we must deduct those torpedo-carrying aircraft whose torpedoes have not been replaced by bombs or rockets. It should not be forgotten, also, that the bigger Marine units have retained their own small air support forces. Notable among the carrier-borne aircraft is the Vought F4U4 "*Corsair*," which has been indefatigably in action throughout the campaign ; this is a fighter-bomber armed with six .5-in. cal. machine-guns or four 20-mm cannon and capable of carrying two 300-lb. bombs. At any rate, 350 aircraft from the 7th Fleet and the British squadron took part in the crushing attack on Imchon on 14th September.

Counting all these units there should have been in the neighbourhood of 600 British and American machines on about 10th July, against 130 North Korean. Two months later the 2000-odd fighters and bombers under the orders of General MacArthur found the skies clear of all opposition.

The effect of bazookas, aircraft rockets and fire-bombs : Russian-built tanks knocked out somewhere in Korea.

*Methods and Results.*

Up to the end of July the unfortunate members of the first American regiments to be landed in Korea took a very poor view of their comrades of the Fifth Air Force, whom they reproached bitterly with being powerless to halt the advance of the tanks. In No. 7 of *Interavia Review* we tried to dispose of these grievances, founded as they were on ignorance of the facts. It was already clear at that time that with 100 to 150 sorties per day spread over a front of 150 miles or more, the infantryman of the 24th Infantry Division could not have seen many more aircraft overhead than the brave Swiss rifleman during the Swiss Army's great autumn manoeuvres. Moreover, with a range of 1100 miles the *Shooting Star* could remain over the battlefield for only a few minutes.

A fortnight later, everybody at the front, from the corporal to the war correspondent, agreed that the miracle of the Naktong had come down from heaven and that jet fighters in particular were a wonderful weapon when used in support of ground operations. What had happened ?

Nothing that was not logical and natural. First of all, the American air forces increased in size, trebling or perhaps even quadrupling their strength of 25th June, thanks to a magnificent transport organisation. The number of sorties is proof of this, as is seen from the following table :

| | |
|---|---|
| 4th July : | 34 sorties |
| 26th June—10th July : | 1570 sorties, i.e. an average of 104 a day ; |
| 12th July : | 150 sorties ; |
| 14th July : | 250 sorties ; |
| 15th July : | 190 sorties ; |
| 6th August : | 550 sorties ; |
| 8th August : | 397 sorties ; |
| 16th August : | 99 sorties, *B 29's* over Waegwang ; |

23rd August : 550 sorties ;
28th August : 556 sorties ;
29th August : 512 sorties, etc.
Record no : 792 sorties.

These figures do not take into account the participation of carrier-borne air forces in the ground fighting. On 16th August alone Tokyo reported 198 sorties by aircraft of the 7th Fleet. All in all air support has functioned to the full since 1st August, weather permitting. The monsoon has a very hampering effect on the course of operations. Thus, for example, torrents of rain fell incessantly along the Naktong front between 2nd and 9th September, although by this time the worst was over.

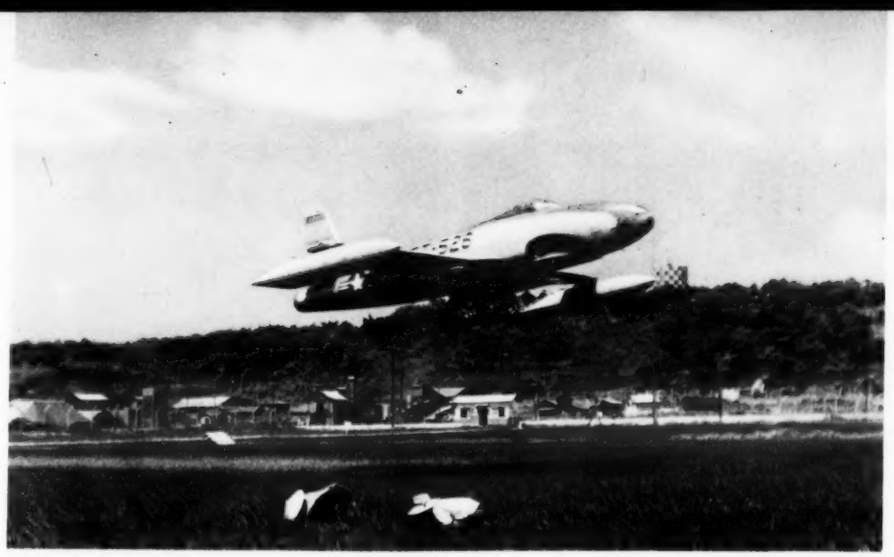
Furthermore, between 28th June and 15th August the line of battle advanced towards the Japanese bases of the Fifth Air Force by 150 miles, i.e. the distance between Seoul and Waegwang as the crow flies. Now, the distance between Simoneseki and Waegwang, the centre of the fiercest fighting in the Naktong battle, is less than 190 miles.

On 14th July, the military aerodrome in the Pohang area, known by the military code name *Cleveland,* came into operation. Thus the front was now only a few miles away. Unfortunately for the Americans, a last offensive by the North Koreans at the end of August forced them to evacuate this airfield somewhat hurriedly.

According to the well-known French engineer and military writer, Rougeron, the fuel capacity of the *F-80 "Shooting Star"* jet fighter has been increased from 375 to 625 U.S. gallons by adding auxiliary tanks. With this arrangement the type should be able to operate for 25 minutes 400 miles from its base.

Finally it appears that since 1st August ground-air communications have functioned to the satisfaction of both parties, as it did in Normandy and at the time of the breakthrough of the Siegfried Line. Such was not the case at the beginning of the campaign, owing to the lack of trained personnel, particularly as certain types of radio equipment hurriedly taken out of store were found to be completely unserviceable. Once again we see that everything can be prepared, but precious little can be improvised.

The various factors we have cited logically account for the inevitable outcome of this tragic trial of strength, following the first check to the North Koreans on the Naktong River. This is the moment when the first doubts seized the officers of General Kim Ir Sen in the line of battle. In a notebook found on the body of one of them after an American counter-attack, we read :



The Lockheed F-80 "Shooting Star" jet-propelled fighter bomber has refuted its earlier critics and proved the value of this category of aircraft in ground-strafing operations. This picture, taken last August, shows an F-80 taking off from its base in Japan. The Japanese in their rice paddies take these modern weapons of warfare without batting an eyelid : rice is more important to them than jets.

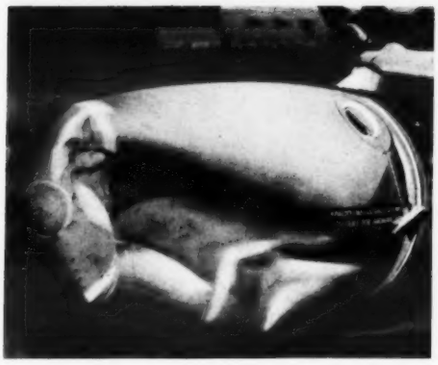
16th August : *All machine-guns and all mortars destroyed by aircraft.*

18th August : *Wish we had some aircraft to set against theirs. Do not see how we can do battle without air forces.*—And this tragic question : *What shall we do without ?*

It is true that the Pyong-Yang infantry, with a tenacity worthy of a better cause, is still resisting and here and there is succeeding in infiltrating dangerously into its opponents' positions. But the tanks are incapable of exploiting these local gains. They are becoming rare at the front and those which remain in a fit state to fight in this infernal bombing have very poor supplies of fuel and ammunition. By day all movement behind the lines becomes impossible. But travelling by night is also not without its dangers. To overcome the handicap of darkness, pilots of the 5th Air Force have thought out the following tactics : two fighters fly along the road and drop light flares : a mile behind them a second patrol of two machines attacks the vehicles thus lit up, then retires after dropping flares to enable the first two to turn and complete the attack. On the 12th September finally, 27 *"Superfortresses"* crushed the last Communist attempt at an offensive by wiping out an enemy pocket at Tabudang which threatened Taegu from the north-east.

Let us remember, however, that what counts when it comes to air operations is the projectile which the aircraft drops. Here, Washington has not repeated the absurd mistakes of Hitler and Goering who thought they could destroy British industry with 500-lb. and 1000-lb. bombs. On the contrary, it has employed weapons which are as varied

Even jets sustain damage in very low-flying attacks. The North Koreans adopted the device of stretching steel cables across the likely approach path of ground strafers. The outer panel of this "Shooting Star" was sheared off by such a cable, but the pilot succeeded in returning to base. The wing tanks are visible.



Small arms fire, light flak, cables and ground wire, flying debris from bomb and rocket blasts are the most frequent sources of battle damage to ground-strafing aircraft. — *Left :* damaged F-80 jet air intake. *Centre :* Damaged F-80 wing tip tank. *Right :* damage to F-80 tail assembly.

as they are effective. The 5-in. rocket, which rendered such excellent service in the Falaise pocket and on the Ardennes roads in 1944, has been used with great success against armour by "*Mustangs*" and "*Shooting Stars.*" As occasion demanded they fired them in salvoes. The 12-in. rocket, nicknamed "*Tiny Tim,*" was found to be the mortal enemy of tracked vehicles : it always pays to be on the safe side. The 5th Air Force was able to claim 71 T34 and 44 tanks destroyed and 73 damaged in one week alone in August ; these are figures equal to the best results in Normandy. When operating against personnel, Major-General O'Donnells "*Superfortresses*" carried a load of 12 tons composed of 500-lb. fragmentation bombs. The *napalm* fire bomb, with a charge of incendiary jelly made from petrol, phosphorus and rubber, is said by American war correspondents to be capable of setting fire to an area as big as a football field.

*

As for the operations of the strategic air units, it was several weeks before their full effects were felt. But from the second half of August onwards, they produced the same paralysing effects on the army of General Kim Ir Sen as had previously been experienced by Kesselring in Italy and Rommel in Normandy. One after the other the harbours of Wonsan, Konan, Imchon, the oil refinery at Chosen, the chemical factories at Hung-Nam, the steel works at Chongjin, the stations, marshalling-yards and junctions at Pyong-Yang, Seoul, Najin Dong Yong San, etc., received a devastating visit from *Superfortresses* which dropped between 500 and 800 tons of bombs on their targets without opposition.

Elsewhere fighter-bombers and light bombers took on bridges, entrances to tunnels and road and rail convoys. On the 20th August patrols of the 5th Air Force destroyed 36 locomotives and damaged 15 others. On 3rd October General Stratemeyer announced that 5223 trucks and other vehicles, as well as 376 bridges had been added to the list. For some days indeed there had been no further worthwhile targets for the U.S. strategic squadrons. According to a report from the Pyong-Yang Government, the American air offensive up to 23rd August had brought about the destruction of 11 factories and 16,504 houses, while nearly 12,000 Koreans in the two zones had been killed or wounded. These figures seem plausible and even if they were exaggerated five weeks ago in an effort to invoke the sympathy of U.N.O., they must by now have been surpassed by events. In Seoul, for example, only one house out of ten is said to be habitable.

These results, both terrifying and decisive, have been obtained by dropping 29,000 tons of H.E. and incendiary bombs. Between 1st March and 1st June, 1944, American and

Anglo-American naval air forces made a decisive contribution to the success of the Allied air campaign in Korea. A Douglas "Skyraider" attack aircraft returns to the flight deck of its carrier.

Casualties were inevitable. The pilot of a Vought "Corsair" naval fighter, badly injured, is rescued by men from an American destroyer.

The smouldering remains of an unidentified Korean town in the wake of the North Korean retreat.

British tactical and strategic units had dropped over 260,000 tons of bombs on their targets in France, Belgium and Holland. The ratio of bombing in 1944 to that in 1950 is therefore close to ten to one. But it must not be forgotten that railways, European style roads, bridges and similar structures, factories and large-scale harbour installations were few in Korea and that local facilities for maintenance and repair were even more scanty. It will therefore be admitted that every raid became a veritable catastrophe for the North Korean aggressors. By 14th September the whole military machinery of the Pyong-Yang Government was threatened by ruin, and one last blow would have overcome it.

*Conclusions*

Victory came to the Americans from the skies. This does not mean that for several weeks the 24th Infantry Division, and later the troops of the U.S. Eighth Army, did not have to fight in appalling conditions against an enemy four or five times superior in numbers ; that if they had given way to panic, the British and American air units would have been powerless to retrieve the situation for many long weeks. The front had to hold.

The defeat of General Kim Ir Sen shows, in addition, how uncertain a victory on the ground is unless it is backed up in the air. Nevertheless, the distance between the 38th parallel and the Waegwang region, where the North Korean offensive petered out, is about 180 miles. Before rejoicing too much in the victory of the American air forces, let us measure this distance on our map of Western Europe, and think deeply.

On 25th August, 1950, five South Korean divisions, four American divisions, one Marine brigade and one British brigade[5] were defending a retreating front, covering about 155 miles. Can we believe that, without breaking, they could have held sectors 15 to 20 miles long without constant support from the flying artillery of the 5th *Air Force?* The extent of the defensive power of the air arm seems to us to be one of the most outstanding lessons of the Korean war. In this connection, the reconditioning of 12 large aircraft-carriers of 37,000 tons and of 15 escort carriers, which is now taking place in U.S. Navy yards, must be greeted with interest. In the event of an emergency there would be 1200 aircraft capable of taking part in a war in the West within a week and 1700 within a fortnight[6].

[5] Of two battalions only.

Helicopters have proved their utility in maintaining communications and evacuating wounded. The picture shows a helicopter of the U.S. Air Rescue Squadron landing, as stretcher-bearers on the Northern Battle front bring up a casualty in readiness to be flown to a base hospital in the rear.

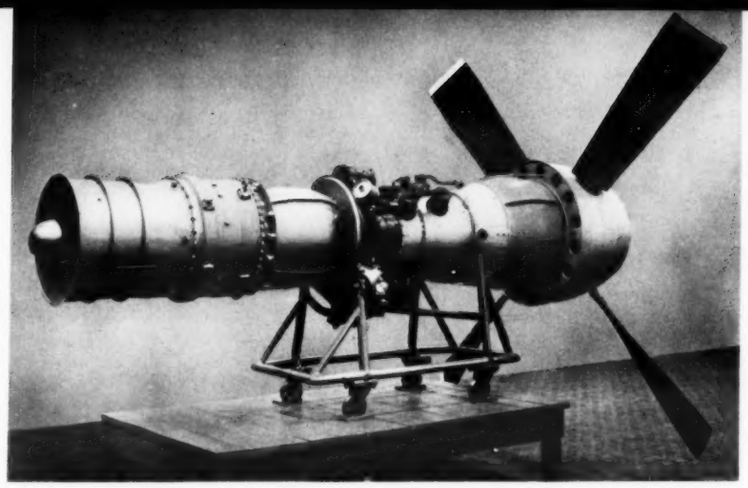
The lightning advance of the Allied forces has been made possible by the Americans' exemplary transport and supply system. Here a Douglas C-54 transport unloads supplies outside what used to be the administration building of Kimpo airfield, a few miles from Seoul. The latter city was still in enemy hands at the time the picture was taken.

We must bear in mind, however, that the Americans encountered only Russian-built *Yak 9* fighters which were "sitting ducks" for their *"Mustangs"* and *"Shooting Stars."* What would have happened if they had been up against swarms of jet fighters such as the *Yak 15* or the *Mig 9* ? We do not intend to answer this question ; it is enough that it should be raised[7].

[6] This shows the tremendous error made by Secretary of Defense Louis Johnson, who last year forced the Navy to abandon the 65,000 ton giant aircraft-carrier *"United States."*

[7] The above article was written early in October. It is not thought, however, that the intervention of Chinese troops in Korea invalidates the conclusions drawn here.

# Progress in Pictures

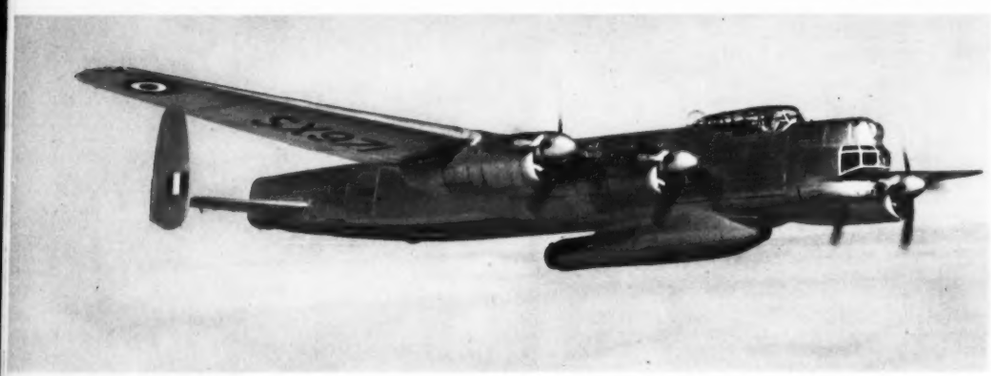


*PRATT & WHITNEY BUILD A 5700 HP TURBOPROP ENGINE*

The well-known American aircraft engine works at East Hartford (Connecticut)—Producers of a long series of air-cooled piston engines from the first 400 h.p. "Wasp" radial engine down to the latest 4000 h.p. "Wasp Major" four bank radial engine. It was not until after the war that they turned to the construction of turbo engines.—The J-42 jet (modelled on the Rolls-Royce "Nene") has been in series production since 1948 and has been followed by the more powerful J-48 (from the Rolls-Royce "Tay"). Now come the trials of the first turbo engine of their own design, the *T-34 propeller-turbine*. All three of Pratt & Whitney's turbo engines bear the additional designation "Turbo-Wasp."

The T-34 (works PT-2) has a 13-stage axial compressor and annular combustion chamber, a three-stage axial turbine and a propeller with four thin-profiled rectangular blades. It is 155 in. (3940 mm) long and has a diameter of only 30 in. (760 mm). Extensive use has been made of heat-resistant steels for all parts subject to thermal stress. Nevertheless, it has been possible to keep the dry weight down to 2550 lbs. (1160 kg). With equivalent output of 5700 h.p. the specific engine weight is therefore 0.45 lbs./HP (0.2 kg/cv). So far over 1400 hours of bench tests have been carried out. A 50-hour run at full power gave a consumption of 0.62 lbs. (0.28 kg) per HP/hr. For its flight tests the T-34 has now been installed in a Boeing B-17 "Flying Fortress." Result : the four engined (now five-engined) standard bomber of World War II is capable of flying on one engine.

*AFTERBURNERS FOR THE ROLLS ROYCE "DERWENT"*



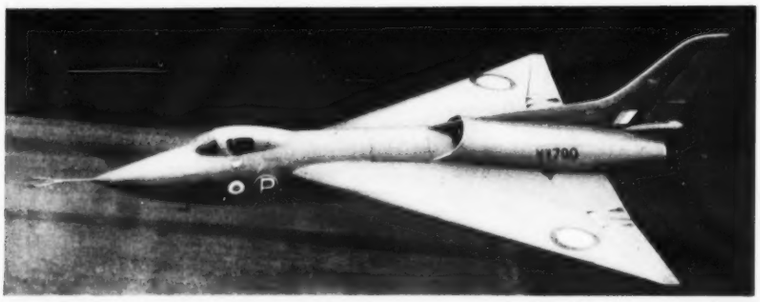
A well-tried jet engine of the medium power class (with double-sided impeller, nine combustion chambers and single-stage turbine), with a maximum thrust of 3,600 lbs. (1630 kg). For military operations the thrust is to be increased by roughly one third for short periods—during take-off or in flight—by the additional injection of fuel into an afterburner behind the turbine. The "flying test bench" used is a four-engined Avro "Lincoln" bomber. As the jet engine had to be fitted below the fuselage, the under side of the "Lincoln's" fuselage had to be sheathed with stainless steel and the old fixed tail wheel replaced by a retractable twin tail-wheel. These modifications were carried out by Air Service Training Ltd., on behalf of the British Ministry of Supply.

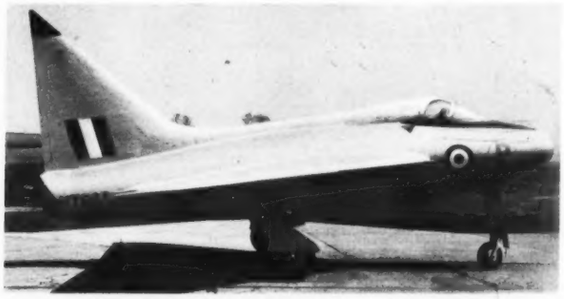
*DELTA WINGS TO THE FORE*

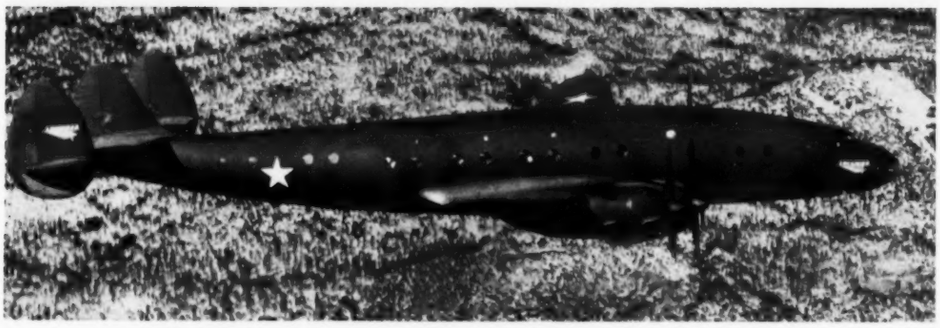
For some time past its supporters have been loud in their defence of the delta wing, which combines maximum sweep-back with small aspect ratio. Wind tunnel tests carried out by the American NACA and the Britisch NPL have already shown that this construction promises both high critical Mach numbers and improved stability and should there fore be suitable for high-speed flight in the trans-sonic range. But now theoretical results have been translated into reality.—The American experimental Convair 7002 aircraft has been followed by two British prototypes, the Avro 707 B and Boulton Paul P. 111. Both have their maiden flights behind them.

The *Avro 707 B experimental aircraft* (above) is the second experimental model of this type. The first was damaged beyond repair last spring. With a span of 33 ft. (10.06 m) and length of 30 ft. 6 in. (9.30 m), it is an all-metal single-seater with ejector seat, and nose wheel undercarriage. The angle between the leading edge of the wing and the longitudinal axis is approximately 38°, and the L.E. angle of sweep-back therefore 52°. The vertical tail surface is also swept-back; elevons are fitted in the wing. A spindle-shaped container beneath the rudder carries an anti-spin parachute which can also be used to shorten the landing. As the Avro 707 B is fitted only with a "Derwent 5" turbojet of 3.600 lbs. (1630 kg) maximum thrust (without afterburner), it would seem that at present it is proposed to try it out only at moderately high subsonic speeds. At the controls : R. J. Falk, Avro test pilot, formerly chief pilot at the Royal Aircraft Establishment, Farnborough.

The *Boulton Paul P. 111* prototype single-seater (below) is also an experimental type. Fitted with a Rolls-Royce "Nene" with 5.000 lbs. thrust (2270 kg), it should reach somewhat higher horizontal speeds than the Avro 707 B. The angle of the leading edge of the wing and of the triangular fin is in both cases 45°; the trailing edges are straight. Ailerons and elevons in the wing, nose wheel undercarriage. Span 33 ft. 6 in. (10.21 m), length 27 ft. 1 in. (7.93 m). Air ducts on either side of the pilot's seat ; single aperture in the fuselage nose.







## *NEW WARES FOR OLD*

The earliest experimental model of the Lockheed "Constellation" which made its first flight as long ago as 9th January, 1943 (left) has been developed into the prototype of the new *Lockheed L-1049 "Super Constellation"* (right foreground). This has been done by fitting a longer fuselage (18 ft. or 5.5 m longer), but retaining the wing and tail unit, and even the engines (P & W R-2800) of the eight-year-old veteran. The L-1049 prototype took off on its maiden flight on 13th October, 1950, The production version of the "Super Constellation"—like the experimental 649 and 749 "Constellation" models—is however to have Wright R-3350 "Cyclone 18" engines with an increased take-off output of 2750 h.p. each and will have an all-up weight of 116.000 lbs. (52.615 kg) for an empty weight of 65.000 lbs. (29.480 kg). Payload, passenger capacity and cargo space have been considerably increased. Eastern Airlines have ordered ten of these aircraft with seating for 92 or 110 passengers and are expected to receive the first of them during the summer of 1951.—Another series of the "Super Constellation" is to be fitted with Wright "Turbo-Cyclone 18" compound engines of 3250 h.p. each and be supplied to the U.S. Navy, with the works designation *L-1049 C*. The U.S. Navy intends to use these aircraft either for radar reconnaissance (service designation PO-2W) or as troop transports (service designation R-70). The maximum all-up weight for the two military versions is envisaged as 130.000 lbs. (58.970 kg). In addition provision is being made in all the L-1049 series for the future installation of higher powered propeller-turbines.

## *PROGRESS OVERDUE... IN AIRCRAFT SHEDS*

In the proverbial fashion of the ostrich these three Convair B-36 heavy bombers are burying their heads... in one of Consolidated-Vultee's largest construction sheds at San Diego. They are not in danger here, since California is still far enough away from the centres of war, cold or otherwise. There was just no more room in the shed for the end of the fuselage of the B-36 and its mighty tail. Not that the building is in any way minute, as we can see by comparing it with the size of the car parked near it. During the war it housed a complete assembly line for four-engined B-24 "Liberator" bombers. Today it is the scene of modifications to the B-36 which is being fitted with four General Electric J-47 jet engines. The time is therefore ripe for further progress... first and foremost in the building industry.

# Deceptive Cat

## *Flight Impressions of the New Douglas "Skyknight"*

BY CLETE ROBERTS

Tab the Douglas Aircraft Company's new twin-jet night fighter a "sleeper." Known as the F3D "Skyknight," it is a blue-black, businesslike looking military plane that promises a combination fighter-bomber-radar service for the United States Navy's air arm. Designed specifically as a night-fighter to rigid Navy specifications, the F3D on succeeding flight tests has demonstrated flying characteristics and abilities that must cause Navy air strategists to dream of battle tactics which previously would have been impossible simply because such an aircraft never existed.

Its need was demonstrated by the Bureau of Aeronautic's invitation to aircraft manufacturers competitively to design and build a night fighter of its type.

Douglas engineers admit they were shocked by the original specifications as laid down by the Navy. At first glance it may have looked as though the air Admirals had a flying battleship in mind : a compact, high speed, tremendously heavy behemoth of the air. Certainly it appeared that the specifications violated all the known laws of aerodynamics. Douglas Chief Engineer E. H. Heinemann told the writer that the high speed demanded by the Navy seemed to be completely incompatible with two other vital requirements, (1) a two-place cockpit arrangement and, (2) a large space for electronic night-fighting equipment forward of the cockpit. Douglas' engineering department declares that the Navy's establishment of such exacting design requirements is a wise move that produces a good plane, and that this is illustrated by the remarkable performance of the "Skyknight."

However wise the Navy policy, it appears that what they wanted in a night fighter and what they got from Douglas added up to a remarkably conventional looking craft with a most unconventional performance.

It is fast. How fast is a security secret. However, it is admitted that the aircraft is in the same speed class as Lockheed's F-80 "Shooting Star" jet fighter. That places it in the 550-600 MPH group.

Second, it's a high-flying airplane. Security again shies from saying at precisely what altitude it operates, preferring to state that it is operational above 40,000 feet. Navy sources have hinted that the "Skyknight" feels perfectly at home at 50,000 ft. plus ! Further, the few Navy pilots who have flown the F3D, indicate that they'd have little difficulty in intercepting a modern super-bomber operating at it's top altitude.

Third, the "Skyknight" has range. When the type was conceived back in 1945, calculations showed that the minimum combat radius requirements could barely be met. Yet Douglas engineers managed to control weight and add fuel tankage to a point where the plane is comparable in many respects to contemporary day fighters. The F3D with inboard and wing tanks can fly non-stop across the United States !

Fourth, and far from finally, the F3D is a slow airplane when a slow airplane is needed. It stalls at an indicated air speed of less than 100 m.p.h. It is completely operational at speeds of 150 m.p.h. indicated, a quality that adds to the remarkable versatility of the plane. Pilots in Korea were said to be praying for a jet plane that could fly like the wind, yet could stooge around at relatively low speeds when called upon to support ground troops. The "Skyknight" can do precisely this kind of military work. Security restrictions necessarily reduce to a minimum a technical description of the new fighter.

However, this much can be said : In most respects the airframe proper of the F3D is conventional. A large percentage of 75S aluminium alloy was used. Construction details are in the Douglas tradition.

A nose wheel type landing gear was chosen for increased stability and safety during high speed take-offs and landings. Since the plane was designed for the critical demands of carrier operation, the engineers equipped it with an auxiliary tail wheel which prevents tail structure damage during landings. All landing wheels are retractable and hydraulically operated.

Speed brakes similar to those developed on the AD "Skyraider" type airplane extend from the aft part of the fuselage by means of hydraulic actuators.

Location of fuel tanks presented a real problem to the designers. The aircraft was to be operated on carriers and that meant a folding wing and the problem of filling a wing tip tank with the wings folded. Solution : it carries all normal fuel inboard in tanks above

In spite of its "corpulent" appearance, the Douglas F3D "Skyknight," a complete masquerader, is a fast, manoeuvrable radar night fighter with an amazing rate of climb. All-up weight : 22,000 lbs. (10,000 kg) ; power plant : two Westinghouse J-34 jets with a total static thrust of 6,400 lbs. (2900 kg).

the engines aft of the pilot's compartment. Auxiliary tanks may be fitted underneath each wing near the folding joint.

Designers ditched conventional wing-tip tanks because of the problem of obtaining lateral control with one tank empty, plus the increase in wing weight resulting from landing loads with the tip tanks full.

The "Skyknight" is powered by two Westinghouse J 34 engines of 3,200 lbs. static thrust each. The power units are so mounted in the fuselage that after the removal of the cowling they can be lowered to handling trucks with a standard bomb hoist. Douglas service crews, using this technique, easily make a complete engine change in a flat 60 minutes.

The aerodynamicist might look askance at the semi-flush nature of the air intake ducts and the off-center axis of the tail pipes. And well he might, for at first glance it appears that, so arranged, both intake and tail pipe would be far from efficient. Its engineers proved in the wind tunnel that the arrangement works. And it took a lot of testing before they found a way to obtain normal duct and tail pipe efficiencies with these arrangements.

As in other jet aircraft, the cabin of the F3D is pressurized and cooled. This is accomplished by an Air Research expansion turbine fed by the engine compressors.

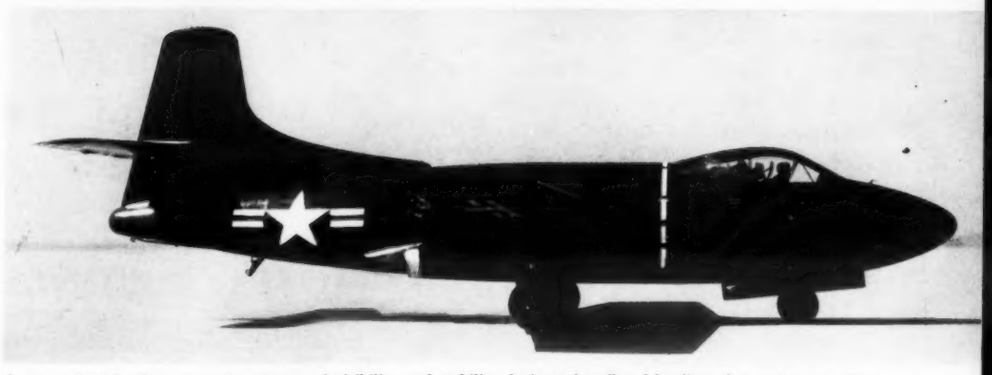
The cockpit is a roomy affair, the standard Navy arrangement, necessarily modified for the side-by-side seating specified. (The radarman occupies the right seat, and the pilot the left.) A special system of cockpit lighting prevents glare. Letters and numbers are etched in transparent lucite on instrument panels and consoles and lighted from behind with a red light. Failure of a bulb will not cause visual loss of the instrument since remaining lights, their beams carried by the lucite, continue to illuminate all panels.

The "Skyknight" boasts a strange-looking flat wind-shield that appears wholly incompatible with high speed aerodynamic design. Yet the wind tunnel experts, conferring with the gun sighting and night vision specialists, determined that the flat design offered the lowest possible drag to meet all requirements.

Perhaps the most unusual feature of the F3D is what the engineers call the "laundry chute." This is a chute big enough for a man wearing a parachute to slide through feet first. The entrance to the chute is located in the bulkhead behind the pilots' seats. A quick release handle opens the hatch on the chute and simultaneously actuates a hydraulically operated door in the plane's belly just forward of and between the jet engines. The lower door, when open, creates a wind-break against the near sonic airstream into which the pilot must fall. To get out of the plane the pilot or radarman simply (1) pulls a lever that causes his seat literally to come apart and break away, (2) opens the escape hatch and (3) feet first, arms folded on chest, slides to safety. There's no chance of hitting the tail, and buffeting from the wind is materially reduced. This manner of emergency exit from the "Skyknight" was accepted after aero-medical studies showed it would be impossible to bail out of an airplane of this performance in the usual manner without injury.

The new-conventional jettisonable seats were considered too heavy. Also, they would have compromised the seating arrangement and equipment, and had the further disadvantage of requiring a sliding cockpit enclosure. Such a design meant the possibility of cockpit pressurization leaks.

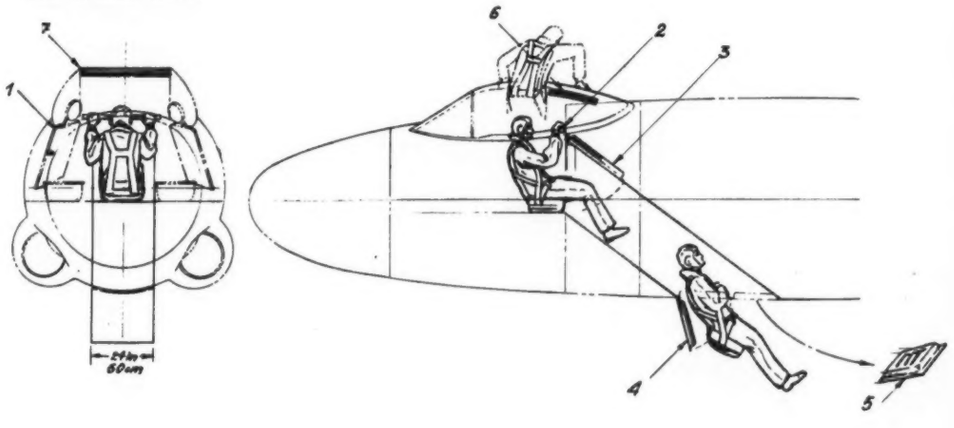
Being a night fighter, the F3D is packed with radar. That means antennas. In earlier aircraft they would be hung on the outside of the plane. But high speeds and resultant aerodynamic problems demanded that every piece of equipment be mounted within the airplane's normal contours. Here, as in other types of latest designs, the electronics experts developed antennas that are safely tucked away in specially designed non-metallic structures such as fuselage nose, fuselage tail, vertical tail tip and dorsal fin. Laminated glass cloth was used in early experimental models of the F3D. However, the engineers indicate, this will be abandoned wherever possible for parts made of conventional aluminium alloy.



A nose wheel landing gear gives increased visibility and stability during take-off and landing ; for carrier operation an arrester hook and auxiliary tail wheel are fitted.

The revolutionary features of the F3D include the "laundry chute," which is also used as normal entrance on the ground ; left, a parachute escape stage by stage.

1 Seat comes apart (seat backs detach and swing into corners ; seat pans slide outboard and aft).
2 "Vaulting" bar.
3 Cabin escape door (open).
4 Hydraulically operated door which forms windbreak during escape.
5 Fly-away door.
6 Ditching hatch (open).
7 Ditching hatch (closed).



The "Skyknight" is deceiving. It doesn't look fast, or particularly big. Its wings are not swept back as one might expect on a plane that packs two jet engines. Its big, radar-packed nose and flat windscreen look as though they'd create a built-in head wind. Did even Douglas engineers underestimate it's speed ? In its initial tests it showed a fleetness that surprised the men who designed it.

First test flights of the F3D were made at Edwards Air Force Base, on the Muroc Dry Lake, California. There, in the clear desert air, Douglas test pilot Russell W. Thaw took her aloft for 30 relatively uneventful minutes. The "Skyknight" proved herself a dependable craft from the first flight. She was into her evaluation tests two days after her maiden flight. Like all new designs the "Skyknight" developed an idiosyncracy or two. For example, there were definite signs of flutter during early speed tests, indicated by a mildly high frequency vibration felt in the forward part of the fuselage. It was eliminated in the usual manner : an oscillograph made an accurate record of the frequency of the vibration which enabled engineers to trace the guilty flutter to the elevator trim tab. Minor modifications were made and the offending vibration scotched.

The writer can say with some authority that such flaws in the F3D's design were wholly eliminated. This was determined with some certainty during a ride in the aircraft a few weeks ago. Riding in the radarman's seat to 20,000 feet plus, following a take-off from Los Angeles' great International Airport, we were impressed with the ease with which pilot Rahn controlled the heavy aircraft, both on the ground and in the air. The F3D weighs 11 tons, about the same as the Douglas DC-3. Yet in taxying and in take-off it answers immediately to the slightest control pressure. The plane has a "soft" landing gear, designed to absorb the jolts from carrier landings. As a result there's a slight sensation of "roll" as you taxi across rough ground.

The "Skyknight" takes off at 110 m.p.h. (180 km/h)... and there's plenty of runway left ! The subsequent climb is breath-taking.

Procedure prior to take-off is similar to other jets. Naturally, there's no warm-up of the engines. Once the fuel and the oil pressure show a satisfactory reading the pilot taxies out for take-off. A short run-up and the "Skyknight" is on her way.

Pilot Rahn had his hands off the control "stick" as he opened the throttles, and he called this to our attention to show off the stability of the heavy plane. In a screaming roar the jets blended with the whine of the air-conditioning turbine. For a moment the F3D was a pretty noisy airplane and, as cadets in flight school say, "We were sure flying slow, but we were flying real loud." Indicated air speed picked up rapidly as the jets urged us forward. The speed read 85, 95, 100... 110—and we were airborne with plenty of runway left.

There was a disquieting moment or two when we noticed what appeared to be blue smoke curling into the cockpit from under a forward panel. Rahn reassured us on the intercom that it was frost forming as a result of a sudden temperature drop in the cockpit. He warned us of another phenomenon which might surprise us : snow would form in the cockpit for the same reason. It did. Tiny white particles came out of nowhere and dropped from the canopy to the floor as we streaked along at hundreds of miles per hour.

Noise was noticeably reduced with flight and the increase in speed. Roars of the jets we left behind us. The only sound that filtered through our tight-fitting crash helmet was the muted song of the air conditioning unit and the fretful crackle of the radio and intercom.

We were impressed with the rock-like stability of the "Skyknight" while airborne. There was no vibration. Everything was solid and looked as though it would remain that way. As a radio reporter we were engaged in making a broadcast of the flight. Our relatively delicate broadcast equipment, a portable unit, was attached to the radar mount. We checked it for vibration and found it functioning as well as though it were on a table in the broadcast studios on the ground.

Security mums quotations on rate of climb. Suffice it to say that we reached ten thousand feet indicated in a surprisingly short time. With the indicated air speed reading much over 400 m.p.h. we pointed "Skyknight's" blue-black nose at the 20,000-foot level and arrived at that altitude before we could find adjectives to describe the breathless climb to our radio listeners.

Controls are single on the F3D. The pilot does all the flying and the radar man concentrates on his search equipment. Absence of dual controls made it impossible for us to fly the "Skyknight." We had to be content with watching the ease with which Rahn put her through her paces. Heavy as she is, bulky as she appaears, the plane answers to control

*Following page 580.*

No warming up is necessary before take-off ; as soon as fuel and oil pressure are sufficiently high, the pilot taxies on to the runway.

*PROFILE OF THE MONTH...*

# Aireporter

BY GENE GACH

If you've ever heard a report radiod from a plane travelling at supersonic speeds, or at superstrata altitude, you probably wondered—as we have wondered—how the reporter could have either the presence of mind, the voice or the equipment to do the transmitting.

If you were in the United States, chances are you were listening to Clete Roberts, author of the accompanying report on the new F3D. His terse reporting, carefully trimmed outsized moustache (see Thomas Dewey, Dean Acheson or Anthony Eden) and hand mike have been standard equipment on every air venture of importance during the last decade.

For USA radio listeners Clete covered the Bikini test, made 23 airlift trips to Berlin during the great airlift ; "aireported" the first flights of the old Douglas B-19, Lockheed "Constellation," and "Constitution," piggyback F-80s, Northrop "Flying Wing," and the Douglas F3D ; radiod on-the-spot accounts of numerous rocket experiments on both coasts.

This radio-aviation expert comes by his calling honestly. He is a licensed pilot with flying experience dating back to the old "Jennies." Aerodynamics, aircraft power plants, navigation, meteorology ; he's studied them all. And he keeps his interest and knowledge up to date.

War perfected techniques of broadcasting from planes. Prior to World War II bulky short-wave transmitters specially installed for the purpose were used. American electronic engineers have improved the wire recorder to amazing efficiency, tone quality and reasonable compactness. Roberts, like many another radio war correspondent, turned to the wire recorder as the means for making "in the air" broadcasts. Installing his first wire recorder in a Douglas A-20 attack bomber at Nadzab, New Guinea, in 1944, he crowded the device and himself into the tiny area behind the pilot to broadcast eye-witness accounts of low level strafing and bombing attacks on enemy airfields.

This was the same method of "actuality"-reporting Roberts employed in Europe in 1945 to enable American radio listeners to participate vicariously in air raids on the Brenner Pass, Northern Italy and Austria.

Recent strides in developing portable, durable recording equipment designed for the rough usage aviation reporting demands, include Hollywood's Bill Stancill's "Minitape" which Roberts now uses on all of his aviation assignments. As small as a doctor's medical kit, light in weight, battery-powered, it can be carried in one hand or lap in a cramped cockpit. Roberts lashes the unit to the fuselage. In a high speed pullout or a screaming 600-m.p.h. dive there is no danger of the recording unit tumbling into the controls, an awkward ending for both report and flight.

Aviation "actuality" broadcasts make strong demands on both reporter and equipment. The recorder must function perfectly during quick and extreme changes of speed, temperature and altitude. It must not miss a beat in a 4 or 5 "G" pull-out. The air reporter must do the same, work as well, talk as rationally, observe as accurately upside down as he does right side up. He must fight against "black-outs" (loss of blood from brain) and "red-outs" (oversupply of blood in the brain). Under the physical strains of high speed flight he must be as lucid as if he were sitting at his studio desk.

Choice of words is important. Roberts disciplines himself against slipping into the flyer's parlance. Since his radio audience are not pilots, he is careful to use simple phrases. For example he translates "our true air speed is . ." to "we are going at so many miles per hour." Instead of "true altitude" he says, "we are so many thousand feet above the ground." This plain talk makes the earthbound audience feel they're with Clete.

Clete Roberts in the Studio.

The pilots with whom he flies approve of his conversion of their jargon into layman's language. One of them observed that "not until after hearing Clete's broadcast did my wife understand what I do for a living."

His most exciting experience ? An eyewitness description of the first rocket from White Sands, made from the desert floor 600 feet from the launching platform. Roberts says it took self control to continue describing the rocket during the moment of take-off. "Its angry roar . . . the engine blast were so terrifying that all I wanted to do was dive in a trench and stay there." Instead he had to make himself describe as objectively as possible the scene he wanted to desert.

His funniest one ? A broadcast at Christmas Island, 160 miles above the equator about four months ago, assigned to the Navy's USS Norton Sound. The guided-missile vessel was engaged in the cosmic ray research study known as "Project Reach," involving the firing of another Viking rocket from its flight deck. Before approaching the island the ship sent Roberts in a helicopter to survey the atoll. To his Minitape recorder in his lap Roberts reported the flight through thousands of sea birds clustering around the whirling craft. He described the sea, the aquamarine lagoon, palm trees bending before trade winds. He recorded how his helicopter was dropping straight down out of the heavens to hover ten feet off the ground in the compound of the native village. Not a native ; not a living soul in sight. The next day he went ashore and found the natives. The village chief, a grey-haired old man in a colourful lava-lava, was asked where the natives were the day before when the helicopter came in. The chief, speaking into Roberts' microphone said, "You fella come along in never-before-see fly-boat. We fella hide in brush. We fella think all along belong him fly-boat from moon or stars."

Clete Roberts *(right)* in his "natural habitat"—on the airfield. Paper work preceding flights includes signing a disclaimer relieving the aircraft manufacturers of liability in case of mishap. He, Roberts, is preparing to go aloft in the first Lockheed T-33 two-seater jet trainer.

Slight pressure with the thumb on the stick—magnified by hydraulic boost units—and the "Skyknight" rolls over docilely on her back, like a great cat.

*Following from page 578.*

pressures with the sensitivity of a pencil-slim day fighter. Hydraulic boost units do the work, move the controls by the slightest finger pressure. Rahn demonstrated this with a slight lateral movement to the right of the control stick. He applied slight pressure with his thumb alone and the "Skyknight," like a great black cat, docilely rolled over on her back and presented her sleek belly and thundering jets to the sky. It was the same story in a screaming dive that reached a speed interestingly close to Mach One. As we reached our safe maximum air speed, Rahn applied the lightest back pressure, again with his finger tips, the nose came up in a several-G pull-out and we were climbing skyward at an indicated 500-plus m.p.h. ! Again, the slight lateral movement of the stick and we were rolling in what appeared to be a near-vertical climb. Ordinary jet manoeuvres ? Yes and no. Ordinary for a day fighter. But obviously out-of-the-ordinary for eleven tons of night fighter designed and built for a relatively mundane job.

The "Skyknight's" performance at high speed was equaled by its behaviour at low speeds. We asked Pilot Rahn to put her through a stall. He did. Throttles back, nose up we sat there. With stick full back, her nose pointed at the blue above we rested on our seat backs and watched the air speed drop. The needle made its counter-clockwise movement, subtracting the miles per hour until the indicator showed a startling 100 ! Still the "Skyknight" hung there, her 22 thousand pounds suspended on her square tipped wings. 90 m.p.h.—and still she stood on her tail ! At an indicated 80 she broke clean, no fall-off on left or right wing. Recovery was routine. We found it hard to believe that this fast and heavy military plane had handled in a stall with characteristics better than a primary trainer. Such a demonstration of slow flight behaviour naturally leads one to think of the range of tasks to which the "Skyknight" might be assigned.

We asked Pilot Rahn if the F3D had ever been landed on a carrier. No, he said, but he'd show us how it will be done. Pointing to the air speed indicator showing a 400-plus m.p.h. speed, he tripped the air brake lever. Immediately we were thrust forward in our seats. The plane felt as though it had rammed into a wall. In a matter of seconds the indicated air speed dropped below the 200 m.p.h. mark. Our true air speed was low enough for a safe landing anywhere. If there'd been a flat top below us we could have squatted with ease on her flight deck !

Rahn didn't demonstrate the single engine operation on the F3D. But he told us of the unusual engine check door that can be closed in flight to reduce the drag caused by a windmilling jet engine. He declared that the ship, because of it's clean design, would glide almost "forever" with both engines shut off in this manner. Air starts, he declared, were a cinch since the blast of air going through engines the moment the covers are opened will speed them up beyond the 1200 to 1800 r.p.m. needed for a start.

Our cat landed as softly as she had sprung into the air. As we slowed, our jets began to sound, not because we were louder but because we were not going fast enough to leave their sounds behind. We had hardly unlashed our recording machine and climbed out when another aviation reporter was taking the radar man's seat, pen and pencil in hand.

He and I were both gypped out of a fine story by military restrictions which ban our discussing F3D's most interesting aspects. Armament and radar are obviously interconnected. Douglas engineers speak in awed tones of the extremely sensitive radar equipment in the "Skyknight's" fore and aft. It was designed by Westinghouse and, hints engineer Heinemann, out-performs any comparable unit in production. We'll have to take his word for it as we didn't see it demonstrated. This much we can say about the electronic equipment on the "Skyknight": it works on intercept forward and it can detect anything that might try to sneak up from behind. Further, the craft's guns are aimed and (this is assumption) probably fired by electronic impulse.

Can the "Skyknight" carry a bomb load of any size ? The Douglas representatives are tight-lipped on that point. But it is obvious that, besides being fast, it is a work horse. It can carry enough gas to go across our continent. Convert that gas load to bombs and it is obvious that thousands of lethal pounds could be hung from the wings.

It is anybody's guess to what many tasks the "Skyknight" may eventually be assigned. She's versatile. She's the brain child of an engineering group that's noted for the variations it develops on a single airframe theme. Douglas' Heinemann figured out twenty-odd adaptations of the early piston-powered AD "Skyraider." It would seem safe to assume that he will handle the F3D "Skyknight" the same way.

The plane will be used primarily for night interception simply because it can do the job as well, if not better, than any aircraft now in production. One gathers this from the engineers who built it. These gentlemen, noted for their conservatism, flatly state that the F3D can successfully intercept any high-altitude bomber that may attack the United States during the F3D's normal life span.

More important than its deception (and its appearance is a shameless masquerade), more important than its versatility (and its speed, range and load capacity are striking), is the "Skyknight's" actuality. It is not a vision on a drawing board. It is not a "one plane only" design. It is in production.

# What's in the Air? *

## *AIR RAID SHELTERS... WITH AMUSEMENT FACILITIES*

The growing activity in uranium mines and atomic industry has brought new cares to the men responsible for civil defence in various countries.

*Air Chief Marshal Sir Philip B. Joubert de la Ferté,* former Deputy Chief of Air Staff,—who was responsible for the introduction of radar in the British armed forces—discusses the question of defence in modern air warfare in an article in the "Daily Mail." He states that although we must reckon with attacks by long-range rockets of the German V2 variety, traditional methods of defence will still be successful provided sufficient up-to-date fighters are available. However, the obsolete "Mosquito" night fighter must be replaced as soon as possible by the Gloster "Meteor N. F. 11." He regarded *Western Europe's most urgent task* as the *creation of an "airtight" radar screen and an up-to-date fighter arm* with a very much larger number of jet aircraft than are at present available.

The requirements of American air defence have been described in very similar terms by *General Hoyt S. Vandenberg, Chief of Staff of the USAF,* who also warns his readers of the mistake of thinking that any defence methods exist which can prevent all enemy aircraft from reaching their target.

A leading article in the New York "Daily News" points out somewhat bitterly that although $50,000,000,000 have been spent on defence during the past four years the USA still have not got a complete radar warning system. A civil defence exercise staged in Chicago on 19th September, in which three A-bombs were supposed to have been dropped over various parts of the city, does not appear to have produced any very satisfying results. In the main it confirms the view of General Lucius D. Clay, Chairman of the New York State Civil Defence Committee, who declared in his official report that with civil defence preparations in their present state an A-bomb attack on New York would cause tens of thousands of casualties.

Since then President Truman has laid before the American Congress (18th September, 1950) a nation-wide *civil defence bill* which provides for the employment of hundreds of thousands of paid and voluntary civil defence personnel. The first task envisaged is the provision of air raid shelters and first aid centres for 140 "critical target areas," which would presumably be the first victims of enemy A-bomb attacks. In their introduction to this Bill the National Security Resources Board maintain that damage and casualties could be reduced by at least 50% through proper organisation and training.

These civil defence measures are to be supplemented by the *re-organisation of the fighter defences* announced by *Air Force Secretary (Thomas K. Finletter).* At a meeting of American aviation journalists in Washington Finletter stated that his first aim, in carrying out the "69 squadron programme" of the USAF, would be to create an effective radar control system for fighters and A/A artillery.

*

Similar measures are being prepared or have already been put into effect by the other Powers.

In *Australia* all new official buildings are being provided with A-bomb-proof shelters, whose walls are to have special protection against radio-activity. Brigadier-General Wardell, head of the Australian civil defence authorities, has ordered a thorough investigation of the special civil defence requirements of industry and administration in all the States of the Commonwealth. Comments and suggestions made by the provincial administrations are to be taken into consideration by the Central Committee for Civil Defence in working out general directives.—On 2nd October, the *Danish Government* authorised the immediate opening of civil defence credits amounting to Kr. 4,500,000 for the repair of old and the construction of new air raid shelters. In addition considerable sums are to be set aside for civil defence out of the Danish defence estimates for 1951-52 (Kr. 358,000,000) and from a special defence credit of Kr. 300,000,000 covering the next two years.—The *Swiss Federal Council* has requested a special defence credit of Sw. Fr. 1,400,000,000 (spread over five years) of which no less than Fr. 300,000,000 are to be set aside for the construction of underground arsenals, aircraft hangars and fuel stores. A/A defences are to be strengthened by the introduction of a new rapid-firing gun and the development of an efficient radar system.—

*H. T. Chapman,* who has been a member of the Board of Directors of *Armstrong Siddeley Motors Ltd.* for 26 years, has been appointed *General Manager* of this British aeronautical firm. Chapman with his wife during a visit to A. V. Roe, Canada.

The *Norwegian Capital,* Oslo, is to have air raid shelters with accommodation for 13,000 persons, to cost Kr. 3,000,000.

The *Swedish measures* are the most far-reaching. The Swedish Government has applied for Kr. 45,000,000 from Parliament to strengthen the A/A defences and build A-bomb-proof shelters. According to a plan put forward by the *Swedish Committee for Civil Defence* shelters are to be provided for a million civilians. These are to be either blasted out of the rock or to have thick concrete walls (30-45 ft. thick). The probable construction costs of Kr. 500,000,000 are to be spread over ten years, and Kr. 300,000,000 of them are to be recovered from "paying peacetime use" of the installations. What this peacetime use is to be can be seen from the design of Stockholm's first air raid shelter, which is 260 ft. long and 30 ft. wide and has a concrete roof of commensurate thickness. The shelter can accommodate 1,000 persons and houses restaurants, hotel, cinema, shops, bookstalls, etc.—Denmark, too, is to rent out its air raid shelters in peacetime as garages and warehouses. However, the question now arises whether these peacetime uses can be cleared away rapidly enough in the event of war to enable the shelters, or at any rate parts of them, to be utilised for their original purpose. In A-bomb warfare time is measured not in weeks or days, but in hours and minutes.

*

In spite of all these defence measures the atomic bomb risk remains, understandably enough, a more than thorny problem for the insurance companies. The *Nordic Congress for Property and Accident Insurance,* which held its three-yearly meeting in Helsinki at the end of September 1950, concerned itself principally with *A-bomb insurance.* It was unanimously agreed that insurance companies could not undertake this form of insurance either in peace or in war, since whole insurance groups would inevitably go bankrupt if they had such liabilities to carry. The question of A-bomb risk could only be dealt with on an international basis and it was extremely doubtful whether a satisfactory solution could be found.

## *STEP BY STEP TOWARDS GERMAN AIR TRANSPORT*

Up until quite recently we received only "*passive* air transport news" from Germany—for example, that

* Based on reports published in "INTERAVIA AIR LETTER," daily international news digest appearing in English and French.—All rights reserved.

International bridge game: *Canada* has undertaken the *training of European military pilots* within the framework of the North Atlantic Treaty. An international bridge table at Crumlin, near London (Ontario). Players, left to right: Sgt. C. Viant (France), Sgt. P. Declerq (Belgium), Lieut. A. U. Vitucci (Italy), Corp. A. C. Roaldstvelt (Norway).

foreign companies had decided to increase or reduce their air services inside Germany, that payment of fares was to be made in foreign or in German currency, —or that one Allied statesman or another had spoken for or against a return to German sovereignty in the air or that members of the boards of former German air transport undertakings had got themselves into trouble over purely theoretical questions (Eckener and Dornier versus Town of Friedrichshafen !).

Today reports from Germany are beginning to be a little more positive. We are not referring here to the recent authorisation of free balloon ascents by Germans, but to an order issued on 5th October by the High Commissioners that German subjects are to be permitted in principle to charter foreign aircraft. For the moment every application must be submitted to the Allied military authorities for prior authorisation. But in time...

Of no less interest is the news that the 1950-51 estimates of the West German Federal Republic include contributions towards the development of Stuttgart, Frankfurt and Cologne (Wahn) airports, and that a sum of DM 300,000 has been spent in order to reduce air fares for businessmen visiting the Berlin Industries Fair to the level of Second Class railway fares. The total estimates for German civil aviation, it is true, still amount to only DM 2,000,000. Nevertheless this is a beginning !

### *REPERCUSSIONS OF THE PAA-AOA MERGER*

Isolated sparks are still flying from the recent display of fireworks which surrounded the absorption of American Overseas Airways by Pan American World Airways.

For example, the American transport workers union, which is affiliated to the CIO (Congress of Industrial Organisations), has threatened to call out a strike because PAA sacked 383 AOA employees after taking over this company. Thanks to the rapid intervention of the Civil Aeronautics Board it was possible to settle the conflict before it became really serious. CAB decided that AOA's parent company, American Airlines, should take over the contracts of its subsidiary up to the expiry of AOA's Atlantic certificate (5th July, 1952) and should pay the back salaries of the 383 dismissed employees.—Even before this decision by the Civil Aeronautics Board PAA had decided to take over 1528 AOA employees. Considering the advantages accruing to them from the merger they ought to be able to find some way of keeping on the remainder of the staff.

*

On the other hand the attempt by one of American Airlines' shareholders to have the transfer of certain AOA shares to PAA forbidden by court order appears to have less prospect of success. In justification of his claim he states that PAA have received a windfall of over twelve million dollars (air mail subsidies, undervaluation of AOA's air fleet, etc.). Presumably the court will explain to the good man that to make even a "very considerable profit" is not a crime, provided it is not obtained by illegal means.—A propos, whatever one may think about PAA's business methods, it is a fact that AOA, a subsidised undertaking, had suffered serious financial losses since the war.

The Argentine I.Ae. 33 "Pulqui II" jet fighter—sketch based on written description.

*

Joseph O'Connell is, so to speak, the second lawyer to emerge from the PAA-AOA affair. After relinquishing the chairmanship of the *Civil Aeronautics Board* he followed the example of his predecessor in office, James E. Landis and joined a New York law firm ; in his case Chapman, Bryson, Walsh and O'Connell. On 19th September President Truman appointed former chairman of the Civil Aeronautics Administration, *Delos W. Rentzel*, as O'Connell's successor. This means there will be close cooperation between these two American control authorities, for Rentzel has been succeeded as *Head of CAA* by his former subordinate *Donald W. Nyrop* (hitherto Deputy Chief of the Traffic Section), with whom he worked in perfect harmony.

CAA and CAB were originally one single authority. CAB, which was formed later, was never over-popular in aviation circles. It was regarded as slow, bureaucratic and irresolute. Rentzel, on the other hand, enjoys the complete confidence of industry and aviation circles. His simultaneous appointment as Head of the Air Coordinating Committee would seem to indicate that the former "three-way traffic" in American civil aviation is to be done away with.

### *JET SURPRISES*

For months past news of the activity of the Argentine State aircraft works *Instituto Aerotecnico de Cordoba* has been scanty. As soon as the I.Ae. 27 "Pulqui" jet fighter developed by this firm had completed its first flights no more was heard about it. No official report on the progress of flight tests was ever published. It was surmised therefore that the design and the performance of the "Pulqui" had not quite come up to expectations.

One fact emerges nevertheless. Whatever may have been the results of the I.Ae. 27 trials it has supplied the makers with useful foundations for the construction of a new *high-speed fighter*, the "*Pulqui II.*" This aircraft has recently been completed with the aid of Professor Kurt Tank (the well-known designer from the former German Focke-Wulff Works) and is now undergoing its flight tests.

The "Pulqui II" (or I.Ae. 33) is a single-seater aircraft with swept-back wing and single rudder unit, also swept-back. The pilot's cockpit is pressurised and installed in front of the wing leading edge above the air intake duct. Air intake centrally in the fuselage nose, Rolls-Royce "Nene" jet engine, jet nozzle in rear of fuselage. The "Pulqui II" is also fitted with retractable nose wheel undercarriage and is said to be armed with four 20 mm cannon mounted in the nose.

The following technical details of the "Pulqui II" have been published :—span 34 ft. 9 in. (10.6 m), length 38 ft. (11.6 m), empty weight 7,920 lbs. (3,600 kg) and all-up weight 12,210 lbs. (5550 kg).—The aircraft is said to reach a maximum speed of 646 m.p.h. (1040 km/h) at a height of 16,400 ft. (5000 m). Its rate of climb is given as 5870 ft/min. (30 m/sec.) and absolute ceiling as 49,500 ft. (15,000 m).

The "Pulqui II" is said to have reached a speed of over 625 m.p.h. (1000 km/h) at a height of 10,000 ft. (3000 m), during its first flight on 17th June, 1950 ! Even for a high-speed aircraft this is remarkably fast for a first flight.—A case of Southern temperament ?

*

Recent weeks have brought us yet another surprise. The British firm *Boulton Paul Aircraft Ltd.*, have started flight testing their P. 111 delta wing *experimental aircraft*, which is to be used primarily for aerodynamic investigation at high speeds. The single-seater P. 111 is a mid-wing aircraft (angle of sweep-back of the wing leading edge 45° ; trailing edge at right angles to the longitudinal axis of the aircraft) with Rolls-Royce "Nene" engine (behind the cockpit).—Span, 33 ft. 6 in. (10.2 m), length 26 ft. 0.8 in. (7.9 m), height 12 ft. 6.3 in. (3.8 m).

### *HELICOPTERS HERE AND THERE*

*Igor Sikorsky*, the well-known helicopter designer, recently stated that he could see no reason why *giant helicopters for 100 or more passengers* should not be built today. They would have speeds of between 100 and 125 m.p.h. (160 and 200 km/h). Technically speaking it would be quite possible to develop helicopters for speeds up to 500 m.p.h. (800 km/h).

Admittedly this sounds a bit fantastic. It is difficult to imagine a "Stratocruiser-fuselage" hovering in the air suspended from two rotors. Even less likely does it appear that the helicopter, which today buzzes round so comfortably, should shoot along at the speed of a fighter. However, we can scarcely suppose that such an authority as Sikorsky would make entirely frivolous statements.—Wait and see !

Meanwhile, new helicopters are being developed in various parts of Europe and the USA, or old types are being improved and tested. At the other end of the scale comes the single-seater *Cantineau-Bétemps C. 100*, now under development in France. This has a three-bladed main rotor and twin-bladed tail rotor. The fuselage consists of a simple steel tube framework carrying the pilot's cockpit and the nose wheel undercarriage ; the rotor and the 80 C.V. engine are fitted above the cockpit.

The single-seater helicopter built by the Brazilian *Fabrica do Galeao* in Rio de Janeiro belongs to the same class. Whereas the French design is at present apparently backed only by the imagination and resources of a few enthusiasts, the Fabrica do Galeao model has been developed on behalf of the Brazilian Air Ministry. A "popular helicopter" built with the aid of State subsidies, or a flying observation post for military purposes ? The results of the flight tests are still to come.

Greater range ! With auxiliary fuel tanks fitted in the wing tips the North American B-45C "Tornado" four-engined jet bomber should have a range of over 1000 miles (1600 km).

# Design of Seaplane Hulls

by John D. PIERSON, Baltimore *

This paper presents a method for the reasonable estimation of hull proportions based upon a consideration of the basic flow conditions during take-off and landing. The effects of step location, hull length, beam and depth on hydrodynamic performance are first considered. Then, the inter-relation of aero and hydrodynamics and weight and balance factors is presented.

## INTRODUCTION

In the early development period of seaplanes, after the fundamental progress to a stepped planing bottom (Fig. 1), the major emphasis in design was to obtain low resistance. This led to an increasing number of model tests to determine hull forms of low intrinsic resistance. Further development indicated the equal importance of optimum trim track, necessary to obtain these low resistances. Thus, resistance, best trim and available trim were the subject of most experimental hull testing for quite a few years.

Rapid advance in the aerodynamic characteristics of all types of airplanes and the severe tests to which flying boats were put during World War II have shifted the emphasis in hull design to the problems of spray, stability and impact loads. Increased wing loading and aerodynamic cleanliness raised the speeds of operation both on the water and in the air, and it is no longer satisfactory merely to provide a large hull for excess buoyancy and clean running on the water. Increased planing and landing speeds have increased dynamic loads at impact and made stability characteristics more important. None of these hydrodynamic characteristics are newly discovered just as a result of increased service requirements, but efficient overall seaplane design requires that the problems which had heretofore been avoided must now be met by understanding and efficient hull design.

The hydrodynamic phenomena considered of importance at the present time are :

1. Resistance and trim.
2. Bow spray at low speeds in rough water.
3. Main spray.
4. Stability.
5. Landing impact.

Due to the difficulty of theoretical hydrodynamic investigations of these problems the greatest advance has been made through the tests of models. It is now generally recognized that a very wide range of model scales can be used when proper test techniques are used. In resistance, trim, spray and directional stability tests the models may be very simple, geometrically similar to the lower portion of a flying boat hull. Dynamic tests for planing stability, bow spray and landing impact require that the model be dynamically similar about the free axis. More advanced models include aerodynamic surfaces and powered propellers to more closely duplicate complete design characteristics. The closest approach to actual operating conditions has been obtained by radio-controlled free-flight dynamic models. However, the uniformity of test conditions and improved accuracy of measurement are continuing reasons to favor the use of dynamic models in the controlled conditions of the towing tank (Fig. 2).

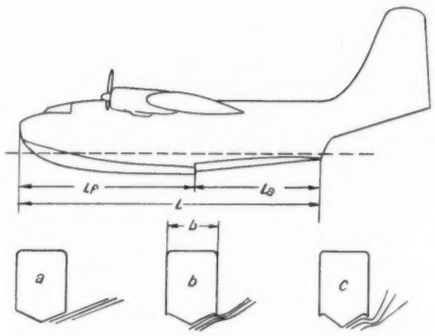



*Fig. 1 : Diagram of the step and planing bottom of a flying boat. The sections show the local spray formation for a conventional hull* (a), *a hull with chine flare* (b) *and with reflex chine flare* (c).

$L_f$ = Length of forebody
$L_a$ = Length of afterbody
$L$ = Total length
$b$ = Max. hull beam.

## BASIC FLOW CONDITIONS DURING TAKEOFF

Between initial rest on the water and flight there are at least five fairly distinct flow conditions. Although the appearance and action of the seaplane as it passes through these stages may depend upon gross weight and aerodynamic effects, *these conditions are primarily a function of speed through the water.* To provide a basis for discussion of seaplane hydrodynamic problems these basic flow conditions are illustrated in Fig. 3. The various components which interact to determine the attitude of the hull are shown diagrammatically in the same figure.

*Fig. 2 : The NACA tank at Langley Field with towing carriage and model of a four-engined flying boat.*

Aerodynamic forces (L) are important as they determine the portion of the gross weight (W) which must be supported by water pressure (W-L). In most boats the range of trim angle is small enough that the air load increases as the velocity squared to equal the gross weight at the get-away speed. At high speeds near getaway, aerodynamic control of attitude with elevators is possible, but at low speeds the moment due to thrust is the major aerodynamic moment. The combined aerodynamic effects are shown as a lift and moment at the airplane centre of gravity in the force diagrams.

Static pressures on the hull provide buoyancy at rest. With increase in speed the hull rises and the afterbody runs in the forebody wake so that the total support from gravity pressures rapidly diminishes.

Dynamic pressures are oftentimes associated mainly with the planing condition. This viewpoint is entirely too limited. Even at very low speeds, with the major weight borne by static pressures, the effect of the local dynamic pressures may be seen in waves and spray. In study of the seaplane hydrodynamic problems every motion or acceleration of the water must be considered as a source of dynamic pressure ; the greater the disturbance to the water the greater the pressure.

The relative growth of the forebody dynamic pressures is shown in the force diagrams. Maximum pressure occurs at the intersection of the hull bottom with the water surface where the advancing hull gives the greatest disturbance to the previously undisturbed water. These pressures on the forward part of the hull tend to lift the bow at low speeds. With increasing speed the water-borne load decreases (due to air lift) while the bottom pressures increase so that the required area for support rapidly becomes smaller. This brings the forebody load centroid closer to the position required for a balance of all loads about the centre of gravity.

The afterbody static pressures rapidly disappear as the step vents. At intermediate speeds up to the hump the afterbody must still supply a load sufficient to balance the total moment about the centre of gravity. This load is supplied by the pressures due to the afterbody riding in the wake from the forebody.

## MAIN STEP LOCATION

The importance of the position of the main step on a seaplane may be seen by a consideration of the planing conditions (IV and V). The reaction of the water is primarily confined to the forebody (that portion of the hull forward of the step) because of the separation of the flow from the body by the sharp step discontinuity. The water reaction is therefore located relative to the step and

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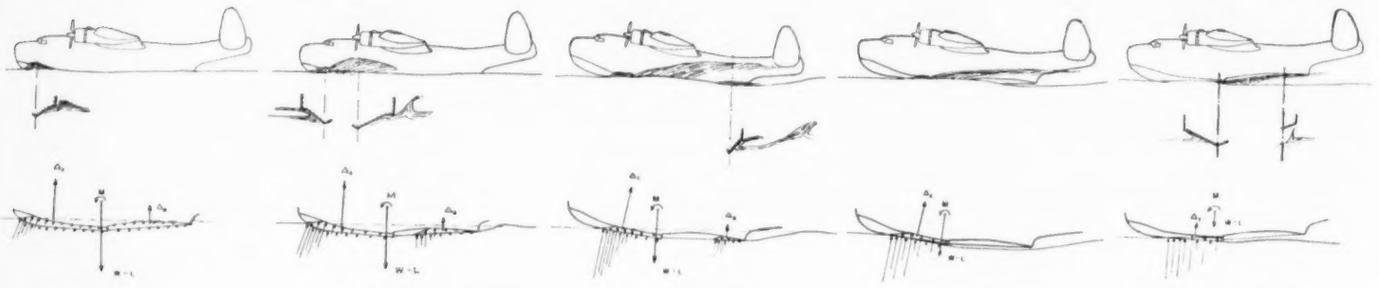



*Fig. 3 : The five hydrodynamic stages during take-off : Spray formation (above) and forces and moments (below).*

~ Water-level
*W-L* Weight minus air lift
*M* Air moment
$\Delta_f$ Water load on forebody
$\Delta_a$ Water load on afterbody

the step position determines the moment of the water reaction about the airplane centre of gravity.

At the onset of single step planing the problem of porpoising may arise if the trim angle is too low. Since the trim angle is the result of the balance of aero and hydrodynamic moments, the step must not be far aft as this would result in less nose-up water moment and possibly too low a trim angle for stability.

During landing (similar to high speed planing) it is desirable that the transition from air to water occur without a nosing up tendency (which might result in bouncing or " skipping " off the surface after initial contact). Obviously, this condition will limit the most forward position of the step. If the step is too far forward, the centre of impact and resultant force may be ahead of the centre of gravity and overbalance the aerodynamic moment. This causes the seaplane to nose up, and it may leave the water in a dangerous attitude.

A number of rough and ready rules have been used in the past to locate the main step with respect to the centre of gravity of the seaplane. However, no arbitrary method is generally accepted even for conventional designs, and the recent trend toward radically different overall hull proportions has further complicated the picture. In general, *the step must be located with reference to model test data*, the aerodynamic configuration of the design and with some consideration of the type of operations to be required of the particular seaplane. Since an approximate step location must be selected at the beginning of the hull design, allowance should be made for a change in position on the basis of subsequent studies.

## Afterbody Length

A review of the basic flow conditions shows the afterbody affecting the attitude of the seaplane only up to the hump speed (Fig. 4). A greater supporting area in the rear results in a more favorable trim angle so that resistance is reduced. Also, the onset of planing is somewhat delayed and occurs with a milder transition so that porpoising is less likely to appear.

*Fig. 4 : The four-engined Glenn L. Martin JRM-1 " Mars " seaplane at hump speed.*

Another condition, the dynamic motion during rough water impact, has recently been recognized as a very important factor in afterbody design. This condition is briefly summarized in Figure 5. When the afterbody is sufficiently long, it may enter the water at high angles (even at the high speeds of landing), thus providing a steadying influence on the motion of the seaplane in rough water landings. The reduction in the violence of the pitching motion (12° versus 18°) and the resultant load factors (4G versus 7G) which may be obtained (*eg.* in 6.6 ft. waves of 100 to 300 ft. wave length) is quite substantial. Therefore, it is desirable that the afterbody be made as long as possible, at least to the extent that the desired action in rough water is obtained.

## Hull Beam and Forebody Length

Not many years ago the determination of the proper hull beam was considered of paramount importance. The static beam loading coefficient (gross weight divided by density of water and cube of the beam [1]) was used, almost entirely, as the measure of the load capacity of a seaplane design. Unsatisfactory performance of several hulls lent support to the idea that there was a definite limiting value to the beam load coefficient for a good design. However, more recent developments in tests and theory have indicated that the beam load coefficient by itself was not a good measuring stick, and it is now used only as a convenient reference coefficient.

From study of the results from extensive series of tests it now appears that the length of forebody (or complete hull) is very important in the determination of the load carrying ability of a hull. In fact, with respect to the formation of spray, the length appears squared with respect to the beam. On this basis a load coefficient may be expressed as gross weight divided by the product of beam times length squared.[2]

As a natural consequence of the decreased importance attached to beam and the corresponding premium on length the current trend of design is toward a greater ratio of length to beam (from $L = 6b$ to $L = 12b$ and more). Apparently, equivalent resistance and stability characteristics can be obtained to large values of length-beam ratio (at

[1] The static beam loading coefficient, $W/\gamma b^3$, is a non-dimensional figure, as the gross weight is expressed in lbs (or kg), the density of water, $\gamma$, in lbs/cu.ft. (kg/m³) and the beam b in ft. (or m.); present-day values for $W/\gamma b^3$ are generally greater than 1. Ed.

[2] Cf. Ernest G. Stout ; " Development of High-Speed Water-Based Aircraft ", — Journal of the Aeronautical Sciences, August 1950, p. 457-480. $K_2 = W/\gamma bL^2$. Ed.

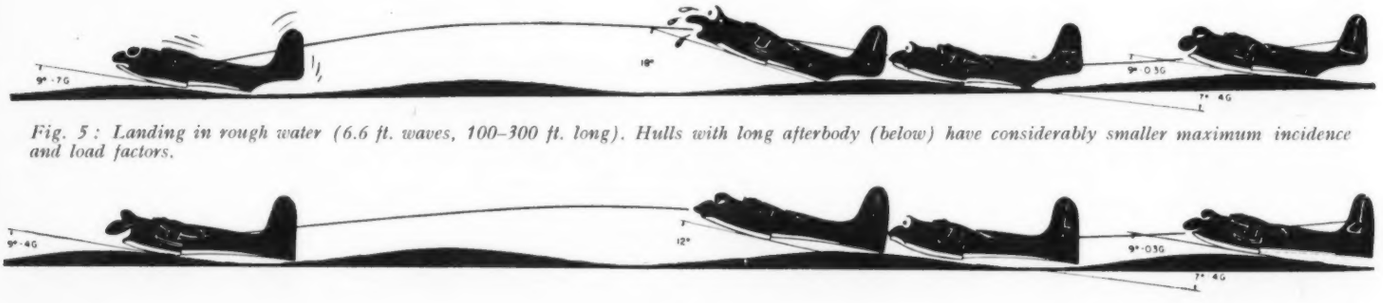



*Fig. 5 : Landing in rough water (6.6 ft. waves, 100–300 ft. long). Hulls with long afterbody (below) have considerably smaller maximum incidence and load factors.*

least to $L/b = 15$), while a reduction in hull air drag and structural weight are obtained. This trend is currently in progress so that it is difficult to predict the outcome, but longer, narrower hulls will undoubtedly become common.[3]

Since the overall length of airplane from centre of gravity to sternpost may be determined from aerodynamic considerations, it may be used as a limit to the afterbody length as discussed above. If such is the case, the beam then should be so chosen that the long afterbody will operate properly at hump and during rough water landing. This will require an approximate ratio of afterbody length to beam of at least *5.0*. The beam, so estimated, may be used as a basis for estimating required forebody length from model basin standard series test data.

### Hull Depth

The hull depth is determined by clearance required for the bow, propellers, wing flaps and tail surfaces. A layout sequence for the hull is indicated in Figure 6, in a preliminary design for which the main step and sternpost are located with respect to the wing and tail (the sternpost angle is assumed to be 9° for the present),

The bow height at chine must be sufficient for low speed taxiing in specified sea conditions. If the forebody length has been chosen by comparison with previous designs for a similar service, the bow height may be directly proportioned to the forebody length (or beam depending on the basis of comparison). When specific data are lacking, a static waterline may be approximated, and additional clearance equal to half the maximum wave height may be used as an approximation.

After the bow chine height has been estimated, the canopy or pilot house may be located. Sufficient clearance must be provided to obtain a good line of sight over the bow and any turrets or other obstacles which may be located in this area. With new flying boat designs, it should be satisfactory to consider the hump trim angle as not exceeding 11° referred to the forebody keel. However, a good view of the water straight ahead should be allowed for at this maximum angle.

The wing height may have two controlling factors, propellers and flaps. Spray profiles may be estimated from similar airplanes or standard series tests. The longitudinal positions of the propellers and wing flaps then determine the vertical position required to clear the maximum spray heights. In general, the height of the propellers is the most critical item, and the wing must be located so that a reasonable wing nacelle fairing may be made. However, adequate clearance in the flap region should not be assumed without checking.

The horizontal tail surfaces may be located to clear the estimated spray profile. When a higher position is indicated for aerodynamic reasons, so much the better.

[3] Cf. Grover Loening: "The Flying-Boat Outlook", INTERAVIA Review of World Aviation, Vol. 2, October 1947, p. 48-50. Ed.

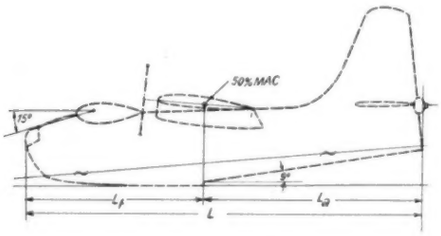



*Fig. 6: Preliminary lay-out sequence for a large flying boat (twin-engined Martin P5M–1 "Marlin" anti-submarine aircraft). The static waterline is indicated by two wavy marks. Adequate clearance must be provided for bow and tail turrets, propellers, landing flaps and tail surfaces.*

### Alignment of Wing-Tail Configuration with Tentative Hull

The first step which may be taken to bring hydro and aerodynamic requirements together is the alignment of the hull and wing-tail configuration for optimum cruising or high speed, whichever is desired. Since subsequent modifications are unlikely to affect the sternpost angle or hull size to a large extent, the crown line, tail configuration and wing incidence may be varied to produce the combination for minimum drag.

At this time it may be necessary to reconsider the spray clearance at the tail surfaces and freeboard problems at turrets or hatches in the stern. Since the depth of the hull at the stern is a large factor in the hull drag, there is a strong tendency to force water clearance to a minimum.

### Preliminary Centre of Gravity Balance

As the hull, wing and tail combination takes shape, the problem of centre of gravity position assumes major importance. With the wing considered as a reference point the main step centroid, tail length and hull afterbody length are relatively fixed. This leaves only a few independent methods of obtaining the required weight balance. Some control is available through the positioning of power plant and by the interior arrangement of equipment, but this may not be sufficient. The only effective method of obtaining major shifts in the centre of gravity position is change in length of the hull forebody.

The hull forebody length is a particularly effective means of obtaining a desired centre of gravity balance, especially since the results of research, which allow compensating variation of the beam with the forebody length, have been accepted. Since several major weight items move with the bow (piloting, electronics, armament and mooring equipment), the centre of gravity may be substantially moved without excessive change in the length. Also, the usual shift required is a forward one, and extension of the bow usually results in a more pleasing appearance as well as improved hydrodynamic performance.

### Effect of Hull Proportions on Drag and Weight

The effect of hull proportions on drag and weight must be considered in the determination of the final beam and hull length. Two studies may be considered; one at constant hull height and the other with hull height a variable.

At constant hull depth the structural weight and air drag decrease with increasing forebody length because of the corresponding reduction in beam. Since relatively constant performance is obtained at constant $W/bL^2$, the planform area is reduced with increasing $L/b$, and the span of the floor frames is less. Overall bending of the hull may be slightly increased, but this is considered to have a minor effect on the weight. The air drag decreases with reduction in the beam (frontal area) until the ratio of height to width is excessive. Then, consideration must be given to a reduction in hull height.

Variable hull height makes the decision on length beam ratio more difficult. At several values of the $W/\gamma bL^2$ parameter the spray profiles must be estimated to obtain corresponding position of wing propellers and tail for adequate clearance. The evaluation of the weight and drag effects is also complicated by the additional variable, since the secondary effects of wing incidence, canopy position, etc., may enter the problem. Nevertheless, at high length/beam ratio ($L_f/b\gamma$ 7) the advantages to be gained may justify the more complicated study.

### Space Requirements in the Hull

The subject of space requirements in the hull has been given no attention as yet in the hydrodynamic design of the hull. If considered too early in the design, provision of convenient space for each item will lead to the conventional excess volume of past practice. Since the seaplane usually has more volume than the land plane designed for the same purpose, it would probably enforce a beneficial trend to have the hull dimension roughly determined before incidental space requirements were considered in detail. In view of the trend toward reduced beam and hull volume for the same gross load, general arrangement of the hull interior may become more of a problem, but should certainly be no more so than for an equivalent land plane.

There are, however, several items to be considered which may determine certain of the hull dimensions. Very high length/beam ratio hulls may be limited by the width of hull required for satisfactory structural attachment of the wing. Cargo or bulk-handling flying boats may have definite volume or compartment sizes specified which will determine beam or length independently of the hydrodynamic characteristics. These factors should be considered in the initial design stages to limit the area for study of the hydrodynamic problems.

*

It will be noticed that no mention has been made of the determination of step depth, deadrise angles, chine flare, etc. It is not intended that these should be considered as of secondary importance. However, until the overall configuration of the seaplane design is established, study of the detail construction of the hull lines is useless.

# A Russo-German Turbojet – the M-012

It is a well-known fact that to-day's most powerful turbojets feature axial compressors : they give a higher mass flow per unit of frontal area and improved compression ratios, apart from an appreciable saving in fuel consumption. Examples are the British A.S. " Sapphire " and Rolls Royce " Avon ", the American Westinghouse J-46, General Electric J-53 and Pratt and Whitney J-57, and the Canadian " Orenda ".

The Russians were therefore on the right track when they took up the *JUMO 012* project which they found at Junkers' Dessau Works, and developed it. This was done in spite of their successful experiments with centrifugal-type turbo-engines of British origin. This big German engine for a static thrust of roughly three tons was still in the design stage in 1945. Only certain parts had been produced. The Russians simply moved a group of German engineers and technicians from the Junkers' Works to Kuybishev (on the Volga), where they continued the development work under Dr. Ing. Schiebe. The first experimental engines have now been running on the test benches for some time.

The new turbojet, whose Russian designation is *M-012*, is based on experience gained from its predecessor, the Jumo 004. There were two principal versions of the latter : the 004 B, which was produced in large numbers, had an eight-stage compressor, six combustion chambers and a single-stage turbine. In the 004 H the number of stages was increased to eleven for the compressor and to two for the turbine, while the number of combustion chambers remained the same and the principal dimensions were but slightly increased. The last version of the M-012 H, now in series production in Russia, gives a static thrust of about 4000 lbs (1800 kg) at 9000 r.p.m., *i.e.*, more than double the output of the 004 B.

In lay-out the M0-12 is similar to the M-004 H, but the engine is considerably longer and bulkier (length 177 ins, or 4500 mm., diameter 43 ins. or 1090 mm). The M-012 also features an eleven-stage axial compressor and a two-stage turbine. The combustion chambers have been increased to eight and correspondingly adapted in size. The engine is designed for an air mass flow of 132 lbs/sec (60 kg/sec) and is characterised by the same form and arrangement of intake cowling and " bullet " as its predecessor.

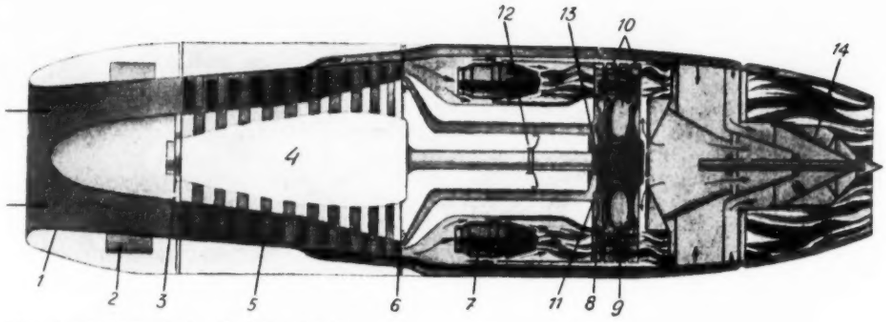



*Fig. 1 : Section of the M-012 turbojet.*

1 Annular entry casing
2 Oil tank
3 Front compressor bearing
4 Eleven-stage compressor rotor
5 Ten-stage compressor stator
6 Labyrinth seal
7 Combustion chamber
8 Front turbine stator
9 Rear turbine stator
10 Two-stage turbine rotor
11 Labyrinth seal
12 Front seal
13 Rear seal
14 « Bullet »

## Structural details

Fig. 1 shows the M-012 engine in section. An annular entry casing with an inlet area of 4.55 sq. ft. )4225 cm²) and an exit area of 3.63 sq. ft. (3375 cm²) serves as intake. The annular oil tank is attached to the inner cowling and thus cooled by the airflow. In the lower part of the entry casing there are three gear-type oil pumps (two pressure pumps and one scavenge pump) and the oil sump with double filter ; the top of the casing carries the accessories. The front compressor bearing, supported by four spokes, and a bevel gear drive for the oil pumps and the auxiliary apparatus (cf. Fig. 2) are located in the flange plane between the entry casing and the compressor casing.

*The compressor casing*, of steel sheet construction, is built in two parts, each half having attached to it ten rows of steel guide vanes, secured from the outside. Behind the sixth stage of the stator compressed air is bled off to cool the jet nozzle. The *rotor* evidently consists (like the Jumo 004) of aluminium alloy discs with inserted steel blades. Under sea level conditions a pressure rise to 95.4 lbs/sq. in (6.70 ata) is obtained. The temperature of the air behind the compressor is 263ºC ; its speed is 452 ft/sec (138 m/sec).

*The burner and turbine casing*, screwed directly to the compressor casing, is also made of welded steel sheet. Of annular section at the junction, it assumes downstream the form of a gun drum, with eight chambers for the burners. Between the labyrinth seal of the last compressor stage and the annular entry slot of the turbine casing there is another annular opening to supply cooling air to the turbine. This cooling air is then conducted by eight separate tubes. A *bearing support* (for the rear compressor bearing and the two turbine bearings) is attached to the outer walls of the turbine casing by eight bulkheads situated between the combustion chambers, and has specially reinforced hoisting eyelets for lifting the engine. In the rear part of the turbine casing (in front of the turbine) there is a *hot gas collector*, to which the eight combustion chambers are screwed.

*Fig. 2 : " X-ray " picture of the mechanically operated parts of the M-012.*

1 Bevel gear
2 Oil pressure pumps
3 Accessories support
4 Speed regulator
5 Compressor rotor
6 Turbine rotor
7 Injection pumps
8 Oil centrifuge (air separator)
9 « Bullet »
10 Front scavenge pump
11 Rear scavenge pump
12 Free drives

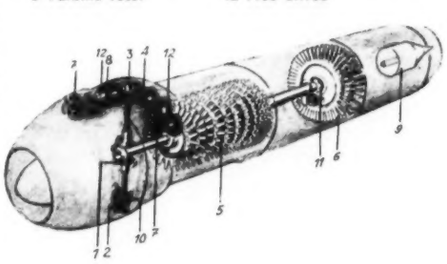
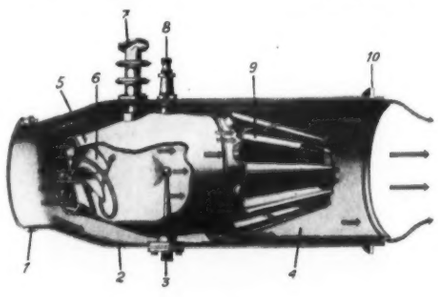


*Fig. 3 : Structure of a combustion chamber.*

1 Sealing ring
2 Mantle tube
3 Injection nozzle
4 Flame tube lining
5 Combustion muffle
6 Guiding vanes
7 Igniter tube
8 Spark plug
9 Slot mixer cone
10 Connecting flange



The structure of a *combustion chamber* can be seen in Fig. 3. It consists of mantle tube (flame tube), combustion muffle, slot mixer cone and flame tube lining. The compressed air passes through the neck (fitted with a seal) into the forward part of the mantle tube and is there divided into two principal streams : Primary air enters the combustion muffle, is set rotating by guiding vanes, picks up the fuel (injected upstream), and burns it with small air surplus and therefore only partially. *Secondary air* flows round the muffle, cools it and completes on the one hand the combustion (with high air surplus) in the vanes of the slot mixer ; on the other hand it is mixed with the exhaust gases in the flame tube lining, which at the same time is cooled by the secondary air. The latter is thus divided, at the end of the muffle, into three streams which flow through the slot mixer vanes, through the flame tube lining and through the annular slot between the lining and the mantle tube.

For initial ignition, *i.e.* for starting the engine, a *spark plug* is fitted in every second combustion chamber ; neighbouring combustion chambers are started by means of *igniter tubes*. Light petrol is used for starting, since the normal fuel (crude oil, kerosene or heavy petrol) would be more difficult to ignite on account of its higher flash point. As all the combustion muffles are interconnected via the ignition tubes, the risk of individual combustion chambers " going out " during operation is greatly reduced.

The two-stage *turbine rotor*, fixed rigidly to the compressor shaft, has hollow steel blades. The latter, and their guide vanes, are cooled internally by air. In the turbine the hot

gases of approx. 850°C temperature and 69 lbs/sq. in. (4.85 ata) pressure are reduced to a pressure of 21.3 lbs/sq. in (1.50 ata) and a temperature of 630°C (behind the turbine); the speed behind the turbine is 820 ft/sec (250 m/sec). The entire mechanical work produced by the rotor is passed through the hollow main shaft to the compressor, subsidiary equipment and oil pumps.

Now reduced in pressure, the gases flow into the jet nozzle whose exit section can be varied between 3.01 sq. ft (2800 cm²) and 4.53 sq. ft. (4200 cm²) by means of a "*bullet*". In this process the gas pressure at the end of the nozzle (for ground level conditions) drops to 14.2 lbs/sq. ft. (1.10 ata) and its temperature to 410°C. At the same time the speed increases to 1735 ft/sec (530 m/sec) at the end of the nozzle. The jet nozzle is made of welded sheet steel and has an outer casing to carry the cooling air in the annular slot. Its bullet, movable in the longitudinal direction, regulates the gas temperature, the turbine output and also fuel consumption to the most favourable values according to the changing operating conditions. The movement of the bullet is controlled by a servo-motor, connected to the oil circuit. Initially operated by hand, the servo-motor will, when development is complete, be controlled by the speed regulator (fuel control unit).

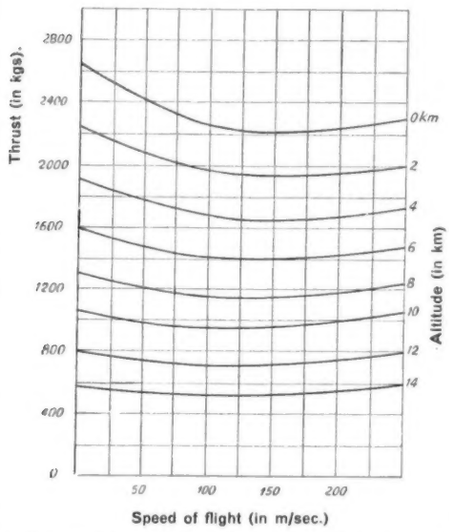



*Fig. 4 : Thrust of the M-012 (at 6000 r.p.m.) versus altitude and speed of flight; theoretical values.*

Fitted to the top of the annular entry casing is an auxiliary drive group. It comprises two injection pumps for the fuel, an oil centrifuge (air separator) and the speed regulator (cf. Fig. 2). At the rear of this group there is an angle drive, to which a flexible shaft for a starter motor can be fixed. Two further drives can be used for other purposes, e.g. operating the aircraft generators.

## Dimensions, weights and performances

With an overall length (without afterburner) of 177 ins., the M-012 engine is among the longest in the world. Its diameter of 43 ins., too is relatively large in comparison with other axial-type turbojets. And owing to the extensive use of steel, the latest known dry weight is still some 4,750 lbs (2150 kg).

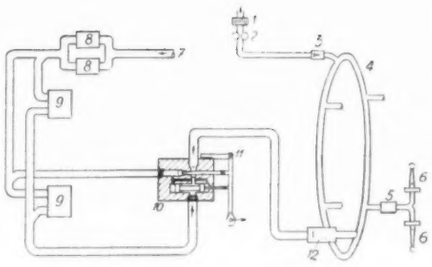


*Fig. 5 : Fuel system in the M-012.*

1 From ignition fuel tank
2 Electrical ignition fuel pump
3 Non-return valve
4 Annular conduit
5 Filter
6 Injection nozzles
7 From operation fuel tank
8 Filter
9 Injection pumps
10 Fuel control speed regulator
11 Power lever
12 Non-return valve

Regarding the maximum static thrust at sea level as approx. 5,850 lbs. (2650 kg), we get a ratio of weight to thrust of 0.81. Contemporary "western" turbojets, on the other hand obtain, considerably better values: the British Armstrong Siddeley "Sapphire", for example, has a dry weight of 2,500 lbs (1135 kg) with 7,200 lbs (3265 kg) static thrust, *i.e.* a ratio of 0.35. It may be assumed that the Russians are trying to remedy this apparent drawback of their M-012 power plant through extensive research into material and detail development.

The thrust at full speed (6,000 r.p.m.)—at various altitudes and speeds of flight—is shown in *Fig. 4*. At a speed of flight of 820 ft/sec (250 m/sec) (or 560 m.p.h. = 900 km/h) a thrust of 5,060 lbs (2300 kg) at sea level and of 2,730 lbs (1240 kg) at an altitude of 26,000 ft (8000 m) is obtained. The specific fuel consumption (per unit thrust and hour) is 1.48 lb/lbt.h (1.48 kg/kgp.h) in the first case and 1.51 lb/lbt.h (1.51 kg/kgp.h) in the second, *i.e.* 40 to 50% greater than for comparable Western engines. Idling speed is about 2000 r.p.m.

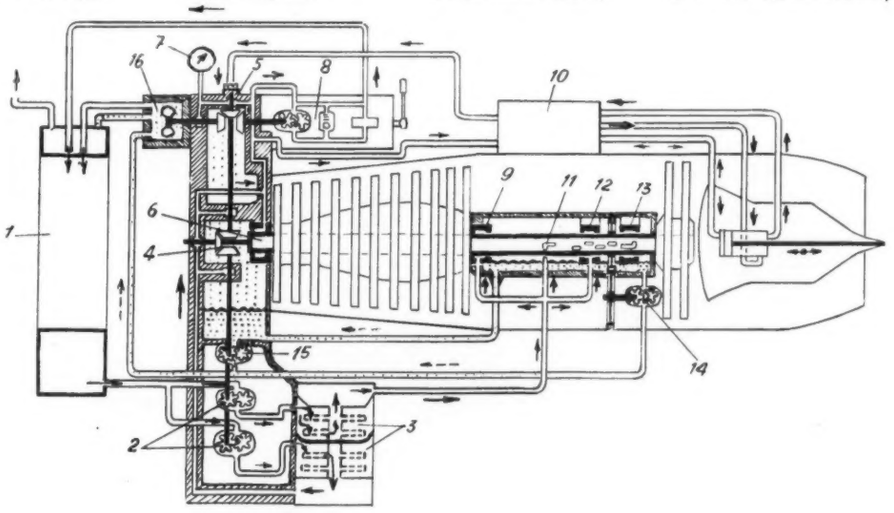
## The Circuits

The *fuel system (Fig. 5)* comprises an ignition fuel system and an operating fuel system, with seperate tanks and pumps. For starting, an outside starter motor is used to get the engine up to a speed of roughly 400 r.p.m.; then light petrol is injected into the combustion chambers and ignited by means of the spark plugs (and igniter tubes). An electrically-driven ignition fuel pump delivers the starting petrol through a non-return valve to the annular conduit and to the nozzles. After ignition the speed is gradually increased, the mechanically operated injection pumps (on the accessories support) supplying normal operational fuel to an increasing measure. As soon as the pressure of the latter exceeds that of the ignition fuel—at about 2000 r.p.m. the non-return valve in the ignition fuel conduit shuts and the engine then runs only on normal fuel. A fuel control unit (with by-pass needle) ensures correct supply of fuel and hence controls the speed. Injection pumps and fuel filters are fitted in duplicate to increase the reliability of operation.

*The lubricating system (Fig. 6)* is constructed on the circulation principle, and also supplies the oil for the hydraulic operation of the "bullet". From the annular oil tank (in the entry casing) two pressure pumps deliver the oil via a double filter in separate leads, on the one hand to the bevel gear, and on the other to the rear compressor bearing and the two turbine bearings (rear circuit). The pressure oil conduit to the "bullet" governor is led off from the front circuit. The oil returning from the rear circuit collects in the bottom of the bearing support and is passed by a scavenge pump to the oil centrifuge (centrifugal air separator) on top of the entry casing; in addition it can—during diving flight—flow into the oil sump in the bottom of the entry casing, by means of a connecting lead. The oil sump also receives the return oil from the front compressor bearing, bevel gear and the subsidiary equipment, as well as that from the "bullet" control. A further (front) scavenge pump sends the oil into the oil centrifuge whence it returns to the annular tank. The purpose of the oil centrifuge is to separate the air from the return oil and thus prevent the formation of foam in the tank. Air and oil then pass in seperate con-

*Fig. 6 : Lubricating system in the M-012.*

1 Annular oil tank
2 Pressure pumps
3 Double filter
4 Bevel gear
5 Accessories support
6 Front compressor bearing
7 Oil pressure gauge
8 Speed regulator
9 Rear compressor bearing
10 Oil spray nozzle
11 Hollow main shaft
12 Front turbine bearing
13 Rear turbine bearing
14 Rear scavenge pump
15 Front scavenge pump
16 Oil centrifuge (air separator)



duits to the oil tank. All the oil pumps are toothed wheel pumps.

*Cooling air for the turbine* is taken from behind the last compressor stage and passes through eight tubes to a distribution chamber (cf. Fig 1). Thence one part flows through the hollow blades of the first turbine stator. The remainder enters the hub of the rotor and thence on the one hand into the hollow blades of the first turbine wheel, and on the other to a space formed by the two turbine discs. From here the cooling air passes not only into the hollow blades of the second turbine stator, but also—via tunnels—into the blades of the second wheel which are also hollow. Whereas the air leaves the guide vanes through their trailing edge, in the case of the turbine blades it emerges through the outer edges.

*Cooling air for jet nozzle* is taken from behind the sixth compressor stage and flows through the annular slot of the double-walled outer casing rearwards. Some of this air is used for cooling the " bullet " support and the " bullet " itself ; the remainder cools the jet nozzle wall and flows out into the open at the end of the nozzle.

The *electrical equipment* of the M-012 comprises, in addition to the electric r.p.m. and temperature gauges, primarily the starting accessories : an electrically-operated ignition fuel pump, an ignition coil and four spark plugs.

### Regulation

During the test runs the speed was still controlled by hand, with the aid of the provisional fuel regulator shown in Fig. 5. The ultimate control system of the M-012 will probably differ very little from that of the M-004 *(Fig. 7)*. It appears that the speed regulator used in the earlier model will also be fitted in the M-012, although new sections for the by-pass valve will have to be worked out and tested. The control mechanism for the " bullet " has been modified. In place of a hydraulic motor with bevel gear, pinion and toothed rod (as shown in Fig. 7), direct hydraulic operation of the " bullet " has been introduced and a suitably modified regulator developed for this purpose. At a later stage of development it is to be coupled with the speed regulator.

*

There is undoubtedly great demand for turbojets of this performance class in Soviet Russia. Twin and four engined jet bombers of the Tupolev Tu-10 and Ilyuchin Il-16 types are waiting to be fitted with more powerful engines. In view of their installation in nacelles underneath the wings, centrifugal-type engines are not suitable. It should be mentioned here that in addition to the M-012, there is another large engine with axial compressor, the M-013, a development of the BMW-003, yielding a thrust of 7,700 lbs (3,500 kg), at a weight of 4,850 lbs (2,200 kg), under development in Russia. In both cases, the problems of reducing engine weight and fuel consumption, and of increasing reliability and operational life are giving Soviet technicians—and their German assistants—considerable headaches.

# Martin 4-0-4 and "Convair-Liner"

The first twin-engined transport aircraft in whose design the experience gained and the theories evolved during the war were fully incorporated is no doubt the Martin 2-0-2 ; it started its flying trials on November 22nd, 1946. Although several modifications were found to be necessary in the course of the trials, notably an enlargement of the fin area and an increase in the upward dihedral of the outer wing panels, the aircraft received its approved type certificate from the Civil Aeronautics Administration on September 3rd 1947. One year after its first flight, deliveries to Northwest Airlines, the Chilean Linea Aerea Nacional, Linea Aeropostal Venezolana and other carriers of the New World were well under way.

It was some time after the conclusion of the tests, on August 29th, 1948, that a serious accident during a hurricane-like storm disclosed that the juncture of the outer panel to the wing centre section was not quite strong enough to withstand the most extreme loads. The Martin 2-0-2s in airline operation had to be withdrawn and returned to the factory, where the necessary modifications were made. Silence has since reigned around this aircraft type, for since the completion of alterations it has given no more cause for complaint.

Many of the contracts which Martin had booked so easily during the first optimistic post-war years were lost, however. For two years later the airline operators estimated their business prospects much more realistically and welcomed any excuse for evading contracts which would have enlarged their air fleets. In the meantime a second transport aircraft of the same class had gone into service, the " Convair-Liner ". It accomplished its first flight on March 16th, 1947, received its final type certificate in February, 1948, was put into operation experimentally on the cargo routes of American Airlines and in subsequent months was delivered to numerous airline operators considerably behind the original delivery schedules.

Today, after two years of practical experience, the " Convair-Liner " is also regarded as a tried and proven aircraft, and it has now become a familiar sight on the air lanes of all continents. But the manufacturers have neglected no opportunity of recovering, by gradually stepping up the sales price of aircraft delivered under repeat orders, at least part of the high development costs which have a tendency to turn the manufacture of commercial aircraft into an extremely unprofitable business. Prior to September 1st, 1947, the price of a " Convair-Liner " was $315,000. Successively it rose to $360,000, then to $450,000 and finally to more than $500,000.

All the same, the Presidents of Trans World Airlines, Eastern Airlines and Glenn L. Martin Co. created a considerable sensation on March 7th, 1950, by announcing the forthcoming availability of an improved edition of the Martin 2-0-2, which will be known as the Martin 4-0-4 and be ready for delivery in the spring of 1951. Thirty-five aircraft were ordered by Eastern Air Lines and forty by TWA, and together the seventy-five aeroplanes will cost about $40,000,000.

*

In what respect will the Martin 4-0-4 differ from its predecessor, the Martin 2-0-2 ? First of all, it will meet the modern requirement for a pressurized cabin for medium and short stage operations. An earlier development of the Martin 2-0-2, designated Martin 3-0-3, was scheduled to be fitted with pressurized equipment. The prototype of the 3-0-3 was undergoing its flight tests in 1948 when work was suspended for reasons of economy. Today this improvement has become an indispensable feature of any aircraft attempting to woo the public away from the pressurized " Convair-Liner ". In the size of its cabin, too, the 4-0-4 will differ from its predecessor. The latter had accommodation for 36 passengers ; the new type bought by TWA and Eastern Airlines will have forty seats like the " Convair-Liner ", and its fuselage will be about 40 inches longer than that of the 2-0-2.

While in the 2-0-2 the necessity for a certain amount of upward dihedral in the outer panels was not discovered until the trials, this will be an *ab initio* characteristic of the 4-0-4. When the wing was redesigned it was found possible to increase the capacity of the outer wing fuel tanks. This resulted in longer range and took care of the future possibility of installing propeller-turbine engines which, unfortunately, require much more fuel than a reciprocating engine.

Until such propeller turbines are operational for civilian purposes, the Martin 4-0-4 will have Pratt & Whitney R-2800 " Double Wasp "

eighteen-cylinder radial engines. In place of the older CA-18 model of 2,400 h.p. for take-off with water injection and 2,100 h.p. without, which also powers the " Convair-Liner ", the later CB-16 model will be used. If 108/135-Octane fuel is available at all points to which the aircraft operates, then the CB-17 model can be installed, which will permit an increase in the take-off power to 2,500 h.p.

*

A modern airline operator about to place a contract for new twin-engined transports will be much less interested in the improvements which Martin's second post-war type will incorporate in comparison to the first. Since he will be faced with the alternative, " Martin 4-0-4 or Convair-Liner ", he will be more preoccupied with the question of whether these two basically similar aircraft still feature differences which, when the types are placed in operation on certain networks of routes, will prove one or the other more suitable. While this question can be more or less decided as regards dimensions and structural details, it would be extremely hazardous to venture a comparison of the weights and performances of two aircraft, one of which has been flying for two years, whereas the second is still in its early construction phase.

In the first case one will have to use figures which were announced on the basis of test results at the time when the aircraft were pressed into service. These figures are more or less out of date, however. On the other hand, announcements and descriptions of new aeroplanes will always contain figures which are subject to change in the course of detail design, actual construction and testing ; finally, they risk being placed on an entirely new basis when the officially permissible take-off gross weight is established.

Our readers will keep these qualifications in mind when considering the figures used in these pages for a preliminary comparison.

*

The most surprising point about this comparison is the great basic similarity of the two aeroplanes. It would be going too far to state that they are as alike as two peas, but they are obviously two aircraft designed for precisely the same kind of use according to precisely the same standards. Let us forget for a moment the delicate matter of weights ! Any aircraft salesman will successfully demonstrate that his aircraft will carry the same load over the same range as his competitors'. Depending upon the prospective buyer, he will find arguments which will enable him to recommend that the engine should be throttled to a greater or a lesser degree, that higher or lower flying levels should be used, that cargo should be stowed either in a concentrated heap or in a more leisurely or orderly manner, that the fuel reserve be larger or smaller. Finally, his arithmetical acrobatics will naturally prove him right.

We remain on firm ground, however, when we state that the wing area of the Martin 4-0-4 is nearly 6 % larger than that of the " Convair-Liner ". In addition, the 4-0-4 will feature Van-Zelm ailerons which were developed by Martins. They are stated to be particularly effective and permit an increase in the landing flap area. Even though the 4-0-4 will finally be certificated for a greater take-off gross weight than the " Convair-Liner ", it probably will have a slower minimum speed than the latter and require a somewhat shorter runway length for take-off and landing. The difference will not be large enough, however, to permit the 4-0-4 to operate from or to airports of a lower ICAO-class.

Judging by the performance figures given in the table, the 4-0-4 is likely to fly somewhat slower than the " Convair-Liner ".

On the other hand, it seems that the permissible and operationally practicable speeds of the " Convair-Liner " are now somewhat lower as a result of the recent increase in take-off weight, so that in this respect also, the difference between the two aircraft will be negligible. But on the whole, the " Convair-Liner " was designed with an eye to speed to a greater extent than its opposite number. This conclusion is justified not only by the smaller wing area of the former, but also by its fuselage cross-section, which is 7 % smaller, and its modern engine arrangement which makes use of the exhaust gases to increase the thrust.

So far, we have not mentioned the possibility of equipping the Martin 4-0-4 with CB-17 engines. This type of power plant needs 108/135-octane fuel, a still comparatively rare type of compromise gasoline somewhere between the current 100/130 gasoline and the 115/145 high performance fuel. With water-injection, these engines produce 2,500 h.p. for take-off and will therefore permit an increase in the 4-0-4's take-off gross weight for a practically unchanged take-off length. The principal result will be to increase the range with full payload by about 235 miles. Climbing performance at full take-off gross weight will be about the same as with the normal engine, and this applies also to the ceiling at the indicated weight. The permissible landing gross weight will be higher, probably owing to the better braking effect of the airscrews, and will amount to 43,000 lbs. In that case, however, a runway length of at least 4,050 feet will be prescribed, which is about the same as for the " Convair-Liner ".

It may be found somewhat difficult to increase the payload in such a manner as to obtain an economic advantage from the increase in take-off weight which may result from the use of the CB-17 engines or from various successful type certification tests. This difficulty may arise out of the fact that cargo and luggage holds are not excessively generous. For short stages, the galley might be omitted. In that case, 48 or even 50 passengers might be carried in somewhat tighter seats, which would boost the payload by 1,300 lbs or 2,000 lbs, respectively.

It would be premature to push this comparative characterization of the two aircraft any further. A final verdict will be given by operators and their pilots once the Martin 4-0-4 is ready for service. Until then, and even beyond that time, development will progress and the situation will remain in a state of flux.

That this situation is unsettled at the present time, is shown by two recent news items :

For the period until it receives delivery of the Martin 4-0-4, Trans World Airline has received a number of " renovated " Martin 2-0-2 aircraft to replace its old Boeing " Stratoliner " and some of its Douglas DC-3 aircraft. These transports, now designated 2-0-2A, carry only 36 passengers and are not pressurized, but they are equipped with the new CB-16 engines. They are certificated for a take-off weight of 43,000 lbs, a figure which exceeds not only the guaranteed value of 41,500 lbs, but even the maximum take-off weight envisaged for the 4-0-4. The landing weight of the 2-0-2A has been fixed at 41,000 lbs like the 4-0-4. Is this an indication that the new type will not be limited to the announced take-off weight ?

*The prototype of the Martin 4-0-4 took off on its first flight on 21st October 1950 (right) ; left a SWISSAIR " Convair-Liner "*

## Principal Characteristics of the Martin 4-0-4 and the " Convair-Liner "

| | Martin 4-0-4 (Announcement of August 1950) | " Convair-Liner " (Makers' Prospectus, Autumn 1948) |
|---|---|---|
| **General** | | |
| Configuration | Low-wing | Low-wing |
| Construction | All-metal | All-metal |
| **Dimensions** | | |
| Span | 93 ft. 3-3/8 ins. | 91 ft. 9 ins. |
| Length | 74 ft. 7 ins. | 74 ft. 8 ins. |
| Height | 28 ft. 5-3/8 ins. | 26 ft. 11 ins. |
| **Fuselage** | | |
| Max. diameter | 9 ft. 8 ins. | 9 ft. 5 ins. |
| Cabin Length | 37 ft. 11 ins. | |
| Height | 6 ft. 3 ins. Useful volume | 165 cu. ft. |
| Width | 9 ft. 0 ins. Floor area | 259 sq. ft. |
| Normal passenger accom. | 40 | 40 |
| for " air-coach " operation | 48-52 | ... |
| Cargo and luggage hold | 344 cu.ft. | 433 cu. ft. |
| Entrance | Integral stairway under rear fuselage | Side entrance forward or in rear ; integral folding stairway optional |
| Pressurization | Engine-driven compressor (capacity 80 lbs/min.) maintains sea level pressure up to 6300 ft. flight level. | Hydraulically driven compressor (capacity 52.7 lbs/min.) maintains cabin pressure at sea level equivalent up to 7,200 ft. |
| Cooling | Expansion turbine, air cooler and water separator. | Expansion turbine, air cooler and water separator. |
| Heating | Hot air ; wall and window heating. | Hot air ; if necessary the air is heated in a heat exchanger by means of exhaust-heated air. Wall and window heating. |
| Air supply | Cabin outlets in cabin roof and laterally above cabin floor ; individual fresh air supply. | Cabin outlet above luggage racks, removal above cabin floor ; individual fresh air supply. |
| **Wing** | | |
| Wing area | 864 sq. ft. | 817 sq. ft. |
| Aspect ratio | 10 | 10 |
| Taper ratio | 2.75 : 1 | approx. 3 : 1 |
| Mean chord | 10 ft. | 9 ft. 8.6 in. |
| Airfoil section | G.L.M. W-16 | NACA 63.4 |
| Dihedral | Centre 3°, outboard 10° | 4° 50' |
| Landing flaps | Double-slot, for trimming purposes coupled with adjustable stabilizer. | Fowler flaps, Length : 26 ft. 8 in. Area : 140 sq. ft. |
| Ailerons | Martin-Van Zelm | Conventional |
| De-icing (wing and tail unit) | Hot air, heated in combustion heaters. | Exhaust-heated air. |
| **Landing gear** | Tricycle with twin wheels on all struts ; low-pressure tires. | Tricycle with twin wheels on all struts. |
| **Engines** | | |
| Two Pratt & Whitney " Double Wasp " with water injection | | |
| Model | R-2800-CB-16 | R-2800-CA-18 |
| Octane rating | 100/130 | 100/130 |
| Take-off power with water injection | 2400 h.p. | 2400 h.p. |
| Max. continuous power : in low supercharger gear | 1800 h.p. | 1800 h.p. at 6000 ft. |
| in high supercharger gear | 1700 h.p. | 1675 h.p. at 13,500 ft. |
| Cruising power in high supercharger gear | 1200 h.p. at 18,000 ft. | 1200 h.p. at 16,000 ft. |
| **Engine Installation** | Conventional nacelles ; Cooling air exit through controllable gills. Combustion air intake through scoop, two exhaust pipes per engine with lateral exits. | Exhaust gases utilised for extraction of cooling air, for heating and de-icing and for residual thrust production. Carburetor air intake inside nacelle, cooling air and exhaust gas exit through jet pipes. " Orange peel " courtings. |
| **Fuel Tanks** | | |
| Type | Six " Mareng " bag-type fuel cells in each outer panel. | Closely riveted fuel tanks in outer panel. |
| Total capacity | 1350 U.S. gallons | 1000 U.S. gallons |
| Fuelling valves | Wing underside | Wing underside |
| **Propellers** | | |
| Type | Hamilton Standard " Hydromatic ", reversible and feathering. | Hamilton Standard or Curtiss Electric, reversible and feathering. |
| No. of blades | 3 | 3 |
| Diameter | 13 ft. 1 in. | 13 ft. 1 in. |
| **WEIGHTS** | | |
| Empty | 27,799 lbs. | 26,416 lbs. |
| Take-off useful load, max. | 14,951 lbs. | 14,084 lbs. [1] |
| Take-off weight, max. | 42,750 lbs. | 40,500 lbs. [1] |
| Landing weight, max. | 41,000 lbs. | 38,600 lbs. [2] |
| Payload : | | |
| 40 passengers at 165 lbs. each | 6,600 lbs. | 6,600 lbs. |
| Passenger baggage (30 lbs. each) | 1,200 lbs. | 1,200 lbs. |
| Cargo (remaining cargo and baggage space at 10 lbs./cu.ft. up to permissible payload) | 2,240 lbs. | 1,500 lbs. |
| Unused load capacity auto weight limitation one to space limitation | 1,550 lbs. | 1,630 lbs. |
| Permissible payload | 11,600 lbs. [3] | 9,300 lbs. [4] |
| Space limited payload | 10,040 lbs. | 10,930 lbs. |

[1] Meanwhile increased by 700 lbs.
[2] Meanwhile increased by 1200 lbs.
[3] Landing weight minus operationally equipped empty weight (29,400 lbs.).
[4] Limited by permissible gross weight with empty tanks (37,400 lbs.). Possibly increased in meantime.

**PERFORMANCE**

| | | |
|---|---|---|
| **Marginal Speeds for Strength Calculations** | | |
| at max. take-off weight | | |
| Level flight | 265 m.p.h. | 280 m.p.h. |
| Steep glide | 335 m.p.h. | 350 m.p.h. |
| Flaps down (depending on deflection) | 120-190 m.p.h. | 160-178 m.p.h. |
| Wheels down | 190 m.p.h. | 200 m.p.h. |
| **Speeds** | | |
| Max. Speed | 312 m.p.h. | 326 m.p.h. |
| at max. continuous power | 1700 h.p. | 1675 h.p. |
| at altitude of | 14,500 ft. | 13,500 ft. |
| at gross weight of | 37,000 lbs. | 38,000 lbs. |
| Cruising speed | 280 m.p.h. | 291 m.p.h. |
| at cruising power of | 1200 h.p. | 1200 h.p. |
| at altitude of | 18,000 ft. | 16,000 ft. |
| at gross weight of | 38,000 lbs. | 38,000 lbs. |
| **Ranges :** | | |
| Engine power and altitude with fuel reserve according to ATA 1949 (300 miles + 1 hr.) : Head wind of 10 m.p.h. with 40 pass., baggage and 1000 lbs. freight | 1,080 h.p. at 10,000 ft. / 450 miles | 1,200 h.p. at 16,000 ft. / about 350 miles [5] |
| with 40 pass. and baggage | 620 miles | about 580 miles [5] |
| with 33 pass. and baggage | 950 miles | about 900 miles [5] |
| Max. range with full tanks, in still air and without fuel reserve | 2,575 miles | about 1,460 miles |

[5] In order to adapt them to the new ATA standards these values are reduced by 140 miles from the original manufacturers' indications (fuel reserve for 200 miles plus 45 mins.). They would be restored roughly to the original indication if the take-off weight increase which has been approved in the meantime were taken into consideration. It should also be observed that the engine power and flying level on which these figures are based differ for the two types.

| | | |
|---|---|---|
| **Take-off and Landing** | | |
| Take-off and climb at maximum approved take-off power, landing at maximum landing weight. | | |
| Rate of climb at sea level both engines | 1,790 ft./min. | 1,440 ft./min. |
| one engine | 460 ft./min. | 270 ft./min. |
| Take-off distance to clear 50-ft. obstacle | 1,780 ft. | 2,870 ft. |
| Landing distance after clearing 50-ft. obstacle | 1,670 ft. | 2,360 ft. |
| Prescribed take-off runway length (take-off with one engine failing over 50-ft. obstacle) | 3,670 ft. | 4,050 ft. |
| Prescribed landing runway | 3,840 ft. | 4,150 ft. |
| Landing speed | 79 m.p.h. | 89 m.p.h. |
| **Ceilings** | | |
| Service ceiling at maximum continuous power | 27,300 ft. | 25,600 ft. |
| at gross weight of | 37,000 lbs. | 40,500 lbs. |
| Maximum operational altitude after failure of one engine, second engine delivering maximum continuous power | 9,800 ft. | 12,200 ft. |
| at gross weight of | 40,000 lbs. | 38,000 lbs. |

The " Convair-Liner " also has considerable scope for development. One step will be the installation of additional tanks in the outer panels, which will enable the fuel supply to be increased by 50 % to 1,500 U.S. gallons. With a given reserve fuel supply, this would increase the practical range by more than 700 miles, although the payload would naturally be reduced. This measure has already been adopted for the eight " Convair-Liners " sold to Garuda Indonesian Airways.

And both aircraft types will later be able to increase their performance by substituting propellor turbines for their reciprocating engines.

The Martin 4-0-4 is so designed as to permit the installation of turbines as soon as they become available. Convair is at present equipping a " Convair-Liner " with Allison T-38 propeller turbines in order to turn it into the prototype of a new " Convair-Turboliner ". However, the Californian company is not contenting itself with pouring new wine into old bottles : while it professes to be willing to help the airlines in the conversion of their aircraft into " Turboliners ", it is already announcing an entirely new turbine aircraft which will take care of any increase in engine power to be expected within a reasonable future.

Thus, the Martin 2-0-2, the " Convair-Liner ", the Martin 4-0-4 and the " Turboliner " are mere milestones along a road whose end is as yet nowhere in sight.

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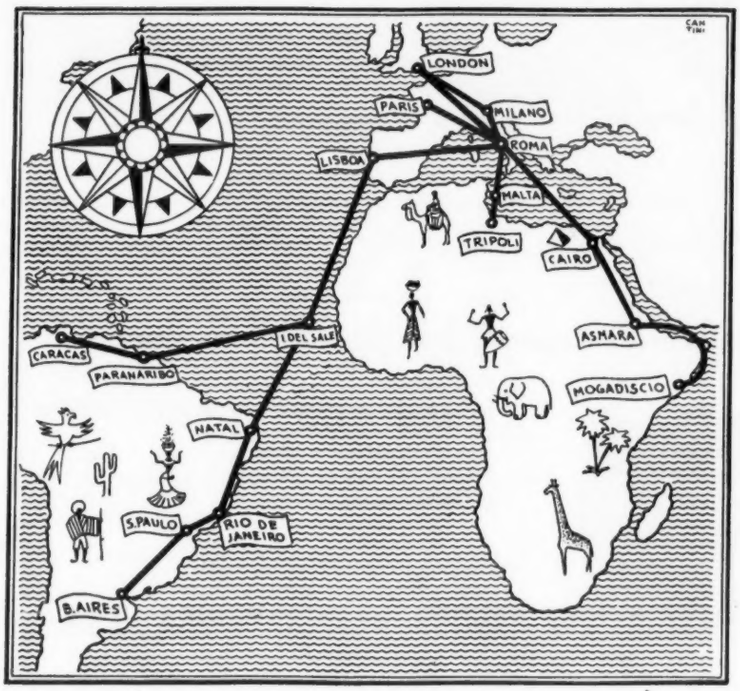


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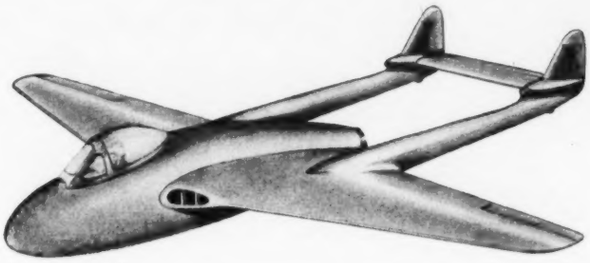

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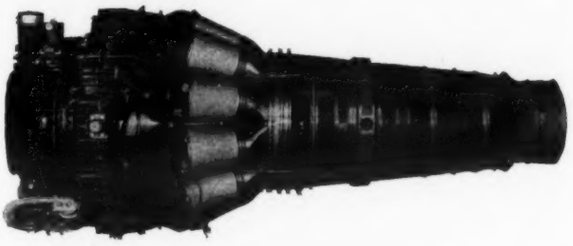

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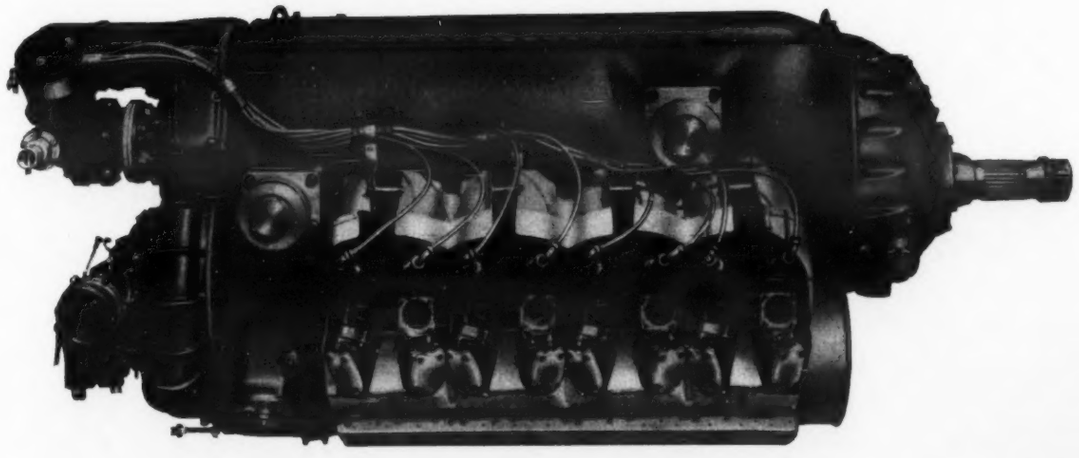

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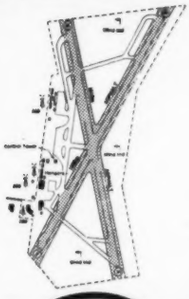

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